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THE
Emporium
OF
ARTS & SCIENCES.

VOL. 2.

CONDUCTED

BY

John Redman Coxe M.D.

Professor of CHEMISTRY in the University
of
PENNSYLVANIA.

Philadelphia. Published by

JOSEPH DELAPLAINE.

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EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 2.] NOVEMBER, 1812. [NO. 7.

NO. 1.

Memoir upon the Vineyards and Wines of Champagne in France: Written in answer to certain Queries circulated by M. CHAPTAL. *By M.* GERMON, *of Epernay.*[*]

PRELIMINARIES.[†]

THE ancient province of Champagne, now divided into two departments under the names of La Marne and La Haute Marne, has been long celebrated as the vineyard of France.

There are two kinds of wines which distinguish this district.

White wines: called *Riviere de Marne* wines.

Red wines: called *Montagne de Rheims* wines.

The white wines are produced from vineyards situated in the valleys and upon the sides of the hills in Epernay, Dizy, Avenay, Cramant, Lemesnil, Monthelon, Chouilly, Moussy, &c.: but in consequence of one of those varieties of nature, for which we cannot always account, the estate of Cumieres, in the midst of so many vineyards celebrated for white wines, and under the same exposure, produces red wines only, and of a quality far superior to the above wines.

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[*] Tilloch, vol. 33, p. 75. From An. de Chim. vol. 61, p. 5.

[†] The numerous facts contained in this Memoir render it truly valuable: although the author expresses himself in the language of a good practical cultivator, he does not always display the accuracy of a modern chemist. We have not hitherto met with any thing more comprehensive on the subject: and it forms the materials of M. Chaptal's projected work upon "*L'Art de faire le Vin.*"—Note of the French Editor.

Among all the vineyards on the river Marne, the cantons of Hautvillers, Mareuil, Cumieres, and Epernay, are the most advantageously situated: they extend along the river Marne, with this distinction, that the quality of the wine falls off in proportion as the vineyard is distant from the river: for this reason Hautvillers and Ay have always enjoyed a preference over Epernay and Pierry; and the latter over Cramant, Lemesnil, &c. and these last over Monthelon, Moussy, &c.

South exposures produce upon the banks of the Marne excellent white wines, but their declivities and posterior parts, which are called the mountains of Rheims, although situated in general towards the north, and almost always to the east, also give red wines of a good quality, and of a fine taste and aromatic flavour.

The slope which overhangs Rheims is divided according to the quality of its wines; hence we have wines of the mountain, of the lower mountain, and of the estate St. Thierry.

The mountain comprehends Verzy, St. Basle, Verznay, Mailly, Taissy, Ludes, Chigny, Rilly, and Villers-Allerand; and among these vineyards, the most esteemed are Verzy, Verznay, and Mailly. The rest, although very good, are of a different quality.

The vineyard of Bouzy, which terminates the chain or the horizon between south and east, and which, therefore, belongs to the two divisions, ought not to be omitted. It produces excellent, fine, and delicate red wines, which, from its exposure, participate in the good qualities of Verznay and the good red wines of La Marne.

The lower mountain comprehends a great quantity of vineyard countries; among which we may distinguish Chamery, Ecueil, and Ville Demange: this last place in particular, when the season is good, yields wine which will keep for ten or twelve years.

The lower mountain extends to the banks of the river Aisne. As the wines it produces are of a middling quality, it scarcely requires to be particularized.

The district of Saint Thierry has taken its name, with respect to its wines and vineyards, from a large extent of grounds containing large vineyards, such as Saint Thierry, Trigny, Chenay, Villefranqueux, Douillon, Hermonville, and produce very agreeable red wines of a pale colour, very much in request by the dealers.

But the wine properly called *Clos Saint Thierry*, and coming from the archbishopric of Rheims, is the only wine which unites the rich colour and flavour of Burgundy to the sparkling lightness of Champagne. *Clos Saint Thierry* holds the same rank among Champagne wines, that *Clos-vougeot* does among those of Burgundy.

In the enumeration of the vineyards of the mountain, some readers may perhaps expect to find *Sillery* mentioned, once so remarkable for red and white wines: the truth is, that Sillery wine is in a great measure composed of the wines produced in the territories of Verznay, Mailly, and Saint Basle, once made, by a particular process, by the *marechale d'Estrees*, and for this reason long known by the name of *Vins de la Marechale*. At the revolution this estate was divided, and sold to different rich proprietors of Rheims: the senator of Valencia, however, the heir to a great part of this vineyard, neglects no means of restoring Sillery to its former reputation.

Series of questions put by M. Chaptal, with their answers.

I. *Which is the most advantageous exposure for the Vine?*

The most advantageous exposure for the vine is, without contradiction, the south and the east; but it has been ascertained that certain advantages of soil and the nature of the plant must also concur: otherwise various districts, such as Damery, Vanteuil, Reuil, &c. with the same exposure and climate, and also watered by the Marne, would enjoy the same celebrity as Cumieres, Hautvillers, and Ay. It must be confessed that the former districts produce inferior kinds of wine; but it remains to be decided whether we ought to ascribe this difference to the culture, the plants, or the soil.

II. *Are the high Exposures, the middle Elevations, or the lower Grounds, best adapted for Vineyards?*

Of all situations, the middle grounds are most esteemed: the heat being more concentrated in them, they are exempt from the variations of the atmosphere which prevail on eminences, and from the humidity and exhalations which issue from the lower regions: the elaboration of the sap or juice is therefore more complete in the middle grounds.

III. *Does an East or West differ much from a South Exposure, in occasioning a sensible difference in the Quality of the Wines?*

A western exposure is unfavourable to vegetation: it burns and parches without any advantage, nor does it give time for the juice to be elaborated, and spread through all the channels of vegetation, when mists, humidity, or dew, succeed: it is a certain fact, that there is a difference of one third in the quality and value between vines situated in east and west exposures.

IV. *Describe the Nature of the Ground or Soil which produces the best Wine.*

Next to exposure, the nature of the soil and of the ground influences the quality of the wine. It must be admitted, however, that grounds with a northern exposure produce wines of a generous and spirituous description; while another exposure, perhaps to the south, yields a poor and common sort of wine. It is therefore to the salts and the juices of the earth, combined with the influence of the atmosphere, that we must ascribe the goodness and qualities of soils adapted for vineyards.

The most proper soil for vines is a sandy granitic earth, neither compact, nor too thick, nor clayey: frequently in the best exposures, we meet with stony soils, which give very strong wines; but warm and dry seasons are requisite in these cases, and a necessary maturity: beneath these stony soils, there are clayey and unctuous parts, and plenty of springs, which conduce to the elaboration of the juice.

In general throughout Champagne the soils proper for vines rest upon banks of chalk. The vine, indeed, comes up slowly in this kind of soil, but when it has fairly taken root it grows to perfection: the heat of the atmosphere is tempered and modified by the coolness of the chalky beds, the moisture of which is constantly sucked up by the vegetative channels of the vine-plant.

CULTIVATION OF THE VINE.

V. *How is the Vine planted?*

In November or December, when the season admits of it, the vine is planted by making an oblong hole or furrow, one foot and a half in depth, by two or three feet in length: the plant is introduced into it and covered with earth, sloping it in such a way as to uncover only two or three inches of the extremity of the plant, to which a horizontal and erect position is also given. Each hole of this kind is one foot and a half from the one adjoining, and on the same line in vineyards where the soil is rich; two feet being allowed in light soils. An interval of three feet is left between the rows of the plants, and care is taken when a new row is begun: the plants must not be placed perpendicularly, and directly above each other.

VI. *What is the Way in which the Shoots are made?*

The plants are inserted into turfs, or in *longuettes.* The longuette is a mere naked twig, which had been left the year preceding, and which is now carefully raised and detached, leaving the young roots behind it.

The turf plant, or *marcotte*, consists in digging up a turf in the marshes, and introducing into it in spring, by means of a hole made in the middle of the turf, the *longuette* or slip intended to be planted: this shoot with its earthy appendage is then fixed in the ground, sloping it as usual: the root is formed in the course of the year, and with a pruning-knife the longuette is cut close to the top of the shoot, and they are then removed by men, or on the backs of animals, in order to be afterwards planted: this last way is the most expensive, but it is the surest, and advances the vine very fast in respect to vegetation.

One hundred of longuettes or bare slips cost four or five livres, and turf plants cost from 12 to 14 livres.

But as two longuettes are requisite for each hole or furrow, when they plant in this way there is a trifling saving, although the other method is far preferable.

VII. *Is Grafting advantageous?*

Grafting is not in general use, except in the vines belonging to the vine-dressers themselves, and in the large plant: these vines when grafted become yellow, and languish. The graft remains for some years exposed to the air, humidity, and to bad management of the labourer, and in short to all the intemperance of the climate.

VIII. *How long does a good Vine Plant last?*

A good vine plant lasts 50 or 60 years, and frequently longer, according to the care which has been taken of it.

A vine plant is deteriorated generally by the bad management of the vine-dressers with respect to the shoots or slips: if they are not sunk deep enough in the ground, the vine plant becomes overwhelmed with roots, which at last form a solid cake, and absorb all the juices from the ground: the vine being thus incapable of shooting, the evil ought to be instantly remedied.

IX. *What Kind of Grapes are best adapted for White Wine?*

Black and white grapes are planted indiscriminately in the same vineyard: and this is perhaps wrong; for the term of maturity is not the same with both kinds of grape. The reason assigned for this practice is, that wine made from black grapes alone would be too vinous, and would become muddy (*sujet á tacher*) in hot seasons; while wine made from white grapes would be too soft: the latter kind of grapes would be too soft, as containing more mucilage (*muqueux*).

X. *Is the Black Grape preferable to the White?—State the Cause of this Superiority.*

There is not much variety in the grapes of Champagne.

The black are generally preferred to the white grapes for several reasons: In the first place, the black grapes resist much better the rains and frost so common about vintage time. Secondly, because there is more vinosity and fineness in the black grape, and it gives more of what is called body to the wine: the white on the contrary is too mucilaginous, renders the wine soft, and exposes it to become yellow, or to thicken.

There are whole cantons, however, such as Chouilly, Cramant, Avise, Bisseuil, &c. where there are but very few black grapes, and yet their wine is in high estimation.

XI. *Which of the Exposures is most subject to the Hoar-frosts of Spring?*

The effects of frost are only to be feared at sunrise: the eastern exposures are consequently most apt to suffer, although it has been ascertained that vine plants freeze in every exposure.

Thus, all the preservative methods hitherto indicated, such as fumigations, or poles armed with long branches of foliage capable of being agitated by the air, are mere reveries of the imagination: they have been employed indeed in small enclosures; but they never preserved a single cluster of grapes, and are incapable of being applied to a large vineyard.

XII. *At what Period is the Vine to be pruned?*

About the end of February or beginning of March, the most essential operation must be performed, namely, that of cutting the plant. When it is very strong, two branches or stumps only are left.

XIII. *How many Eyes are left in the Plant?*

Three eyes upon each branch: when the vine is weak, one branch only is cut off.

XIV. *At what Height from the Ground is the Plant pruned?*

When the plant is young and the rind is not marked with old prunings, the plant is cut at the height of three or four inches: the vine-dressers cut higher, because they frequently cultivate three branches, and leave four eyes.

XV. *To what Height is the Vine allowed to rise?*

Not higher than a foot and a half,—to avoid dilating the sap too much.

XVI. *At what Season does the first Operation in the Vine-yards commence?*

After having pruned the vine, the first occupation is that of hoeing: this operation consists in digging up the earth around the plants, so as to uncover their roots for a moment, and detach the earth from them which may have become clotted; the hoe being always inserted into the earth about a foot from the plant.

At the end of March, or beginning of April, when the thaws have softened the ground, the hoeing commences.

XVII. *What is the Period of Planting by Slips or Cuttings.*

This kind of planting is performed at the time when the vine is planted.

XVIII. *In what Manner is this Kind of Planting managed?*

In pruning, the vine-dresser reserves, in the barest and most sterile places, certain slips, upon which he leaves only two or three stalks, according to the strength of the slip: the hole or furrow being made, the slip is gently inclined, by disengaging the roots, and by means of a pair of tongs the stalks are held while placing in the furrow, at from four to six inches distance from each other: the slip being thus fixed at the depth of a foot or thereabout, a hand-basketfull of manure is thrown at the root of the slip; the hole is then filled up with natural earth in a loose manner, in order to admit of the two or three stalks sending out their shoots without being bruised.

XIX. *How many Operations are there to be performed between the Pruning and the Vintage Season?*

The prunings being over, as the same vines are not pruned every year, and even in those which have been pruned the earth has not been thoroughly stirred, the vines are trimmed at the beginning of May: this trimming is called *labourage au bourgeon*, and is followed by the tyeing up of the vine plants.

XX. *Which is the most favourable Moment for Tyeing and Paring the Vine?*

While the vine is in flower, it must not be touched: it must be pared when the flower has nearly passed away, and at the height indicated in Art. XV.: it must afterwards be tied in such a way as to envelop the slip, without injuring the circulation of the air or the growth of the suckers.

Finally; about the middle of August, in order to clear away the grass from the roots of the plant, and to raise up the grapes which may have fallen to the ground, a third and last trimming takes place.

The following is the routine practised in the vineyards of Champagne:

1. They are cut in February or March.
2. Hoed in March.
3. Pruned in April and May.
4. Tied or propped up in April and May.
5. First trimming for the shoots.

6. Pare and tie in June.
7. Second trimming in July.
8. Third trimming in August.

XXI. *How is it ascertained that the Grape is sufficiently ripe, in order to commence the Labours of the Vintage?*

At the end of September, or later if the season has been backward,—before proceeding to the labours of the vintage, in order to obtain the fruit at the most complete state of ripeness,

The stalk of the grape must be brown and woody;

The grape pendent;

The skin or pellicle of the grape tender, and not brittle when chewed;

When a seed can be easily detached from the juice of the grape: which should in its turn present a vinous and transparent appearance, without having any green in it;

When the grape stones are brown, dry, and not glutinous.

OF THE VINTAGE.

XXII. *What Precautions are necessary for managing the Grapes so as not to injure the White Wines?*

Many precautions, even of detail, are necessary in making white wine.

These consist in carefully picking the ripest and soundest grapes from all withered or bruised grapes; they are then put into panniers, and covered with cloths to prevent the effects of the sun's rays, and to avoid fermentation.

The panniers thus covered, being put upon the backs of horses, are conveyed to the press; into which they are not emptied, however, until after sun-set. From twenty to forty panniers full are put under the press at a time:

the contents of two panniers produce half a piece of wine: forty panniers yield nine or ten pieces of white wine, and each piece contains two hundred bottles.

(To be continued.)

No. 2.

XXI. *Account of a Descent into the Crater of Mount Vesuvius by eight Frenchmen on the Night between the 18th and 19th of July* 1801.*

TO ascend to the summit of mount Vesuvius, which is elevated 3600 feet above the level of the sea, is an enterprise of great difficulty, as it is necessary for nearly half the height to climb an exceedingly steep declivity up to the knees in ashes. Some philosophical men of eminence, however, as Spallanzani, Dolomieu, Dr. Moore, &c. have overcome all these difficulties. Sir William Hamilton, who caused a great many views of Vesuvius to be designed during his long residence at Naples, ascended to the summit of it sixty-two times; but no one, at least since the eruption in 1799, ever ventured to descend into the crater of this volcano, not even Sir William Hamilton, who considered it under so many points of view, and who visited it so many times. It was reserved for eight Frenchmen to hazard this dangerous enterprise, and to succeed in it completely, notwithstanding the timidity of their guides, the impossibility which the Neapolitans attached to it, and the instances they mentioned of rash travellers who had lost their lives in the attempt, and been swallowed up by the volcano.

To be able to appreciate the danger of this enterprise, it will be necessary to have a correct idea of the form and position of Vesuvius, and of the matters which it throws up. This volcano has the form of a truncated cone, and a part of its base, which is altogether three leagues in circumference, is washed by the Mediterranean; its mouth, or upper base, which is a little inclined to the axis, is 5722 feet in circumference. The earth from the base to half the height consists of vegetable mould mixed with lava and stones which have not been attacked by the fire, tufas, pumice, and calcareous stones, different in their nature and colour according to the different degrees of impression which have been made on them by the fire.

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* Tilloch, vol. ii. p. 134.

The half of the height next the summit is composed chiefly of pure ashes, but coarser than our common ashes. Till the present time, there have been twenty-four eruptions recorded in history. The first took place in the year 79 after the christian era: by these eruptions volcanic matters have been successively accumulated, but by that of 1799 the situation of the crater and of the aperture was entirely changed. The focus or crater is now sunk 200 feet below the upper edges of the mouth of the volcano.

To arrive at the crater, and to observe the numerous spiracles, long crevices, and fires which issue from them in several places, and also the variegated and still smoking matters of which the crater is composed, it was necessary to pass over this space of 200 feet.

The inner sides of the volcano are nearly perpendicular, or exceedingly steep, and composed of ashes, lava, and large calcareous stones; but these lava and stones, as they form no connection with the ashes, cannot serve as any point of support; and when any one is so imprudent as to adhere to this kind of rock, the least motion, the least displacement of any part, makes the whole crumble to pieces. Besides, from the summit of Vesuvius to the crater, the declivity, being exceedingly rapid, cannot be traversed but on all fours, and suffering your-self to glide down amidst a torrent of ashes and lava. But the most dangerous obstacles are those awful excavations, which cannot be passed over without great trouble and difficulty.

Disregarding the terror with which the Neapolitans endeavoured to inspire us, after having received their adieus, as if our separation had been likely to be eternal, we set out in a carriage, at half after eleven at night, on the 18th of July, from the hotel of the French ambassador, fourteen in number, furnished with ropes and other articles which we supposed might be necessary, and all in a state of the highest spirits, which never forsook us, even at times of the most imminent danger. We arrived about midnight at the foot of Vesuvius; and, having quitted our carriage, mounted well experienced mules, and proceeding one after the other, with adjutant Dampierre at our head, amidst the thick darkness of night, reached half way to the steep summit of the mountain. We had a numerous body of guides, and their lighted torches gave to our expedition a mysterious and solemn air, which formed a striking contrast with the mirth and gaiety of the company.

When we had ascended about half way, we were obliged to alight, and to clamber up the steepest and most difficult part of Vesuvius, wading through the ashes up to the knees, till, exhausted with fatigue, and covered with sweat, we reached the summit at half past two in the morning.

The first thing that struck us as soon as the morning began to dawn, was a most magnificent spectacle—a superb view of the city and port of Naples, the beautiful hills which surround them, and the vast extent of the sea by which they are washed. After walking round part of the aperture of the volcano, that we might choose the most commodious place for descending, adjutant Dampierre and C. Wickar first descended, without any accident, at the determined point. When they had got about a third of the way they were suddenly stopped by an excavation of fifty feet, which it was necessary to pass. As they found that it was impossible to obtain any fixed point of support on ashes so moveable; and being convinced that the friction of ropes would have soon destroyed both the point of support and the neighbouring masses to a great distance, they resolved to return. Besides, while deliberating on the means of descending, some stones rolling down from the summit occasioned a general agitation wherever they passed: adjutant Dampierre found the ground on which he stood shake beneath his feet; and he had scarcely quitted it, calling out to C. Wickar to follow him, when it disappeared. Soon after, indeed, the whole space where they had stood, and all the neighbouring small eminences, crumbled down successively in the course of half an hour, and were precipitated to the bottom of the crater with an awful noise.

Before we renounced our enterprise to return to Naples, dejected on account of not having succeeded, we once more walked round the mouth of the crater, and at last discovered a long declivity, pretty smooth though very steep, which conducted to the focus. Without examining the precipices which it might be necessary to pass before it could be reached, C. Debeer, the ambassador's secretary, accompanied by a lazzaroni, set out first to attempt the passage. When they had got half way, amidst a torrent of ashes, which the impression of their feet made to roll down along with them, they found means to fix themselves on the edge of a precipice twelve feet in height, which it was necessary to pass before they could reach the lower declivity. The lazzaroni, frightened, refused to proceed; but, being promised a double ducat, avarice got the better of his timidity; he speedily made the sign of the cross over his whole body, and, having invoked the Madonna, and St. Anthony of Padua, threw himself along with C. Debeer to the bottom of the first precipice: soon after they arrived at another, but being of less height it was passed with more ease. At length, amidst a continual torrent of falling lava, ashes, and stones, they arrived at the bottom of the crater, and stretched out their arms to us, sending forth shouts of joy, which we returned with the utmost satisfaction and enthusiasm.

C. Houdouart, engineer, immediately followed C. Debeer; and after encountering the same difficulties, and passing dangerous precipices, joined him at the bottom of the crater. Being there both convinced of the almost insurmountable difficulty of ascending, they threw themselves into each other's arms, like two friends reduced to the necessity of terminating their lives together in a desert island without any hopes of escaping from it.

They then began, but with cautious steps, to walk round this immense furnace, which still smokes in several places. The intrepid Wickar, who was very desirous to participate in their fate, called out to them to send some one to assist him in passing the two cliffs; but seeing no one coming, and growing impatient, he rushed forward, and rolled down towards them amidst a torrent of stones, ashes, and volcanic matters. Adjutant Dampierre, C. Bagneris, physician to the army, Fressinet and Andras French travellers, and Moulin inspector of posts, soon followed, and arrived at the crater after having incurred the same dangers.

Wickar immediately sat down on a heap of scoriæ, and, with that superiority of talents for which he is distinguished, sketched out in profile, with a perfect resemblance, the portraits of the eight Frenchmen who had descended. Each then formed a small collection of the different volcanic matters which appeared to be new or curious, and endeavoured to make a few observations.

Had we been allowed to depend on success, had we not been retarded in our preparations by our timid guides, and if some of us, having only just arrived at Naples, had not been straitened in point of time, our descent would certainly have been much more useful, and the results more satisfactory. However, though ill furnished with means, the following are the observations we were enabled to make:

Reaumur's thermometer, the only instrument we possessed, stood at 12 degrees, on the summit of Vesuvius: the air was cold, and somewhat moist: in the crater the quicksilver rose to 16 degrees, and we experienced the mildest temperature.

The surface of this place, which, when seen by the naked eye, looking down from above, appeared entirely smooth, exhibited, when we were at the bottom, nothing but a vast extent of asperities. We were constantly obliged to pass over lava exceedingly porous, in general pretty hard, but which in some places, and particularly those where we entered, was still soft, and yielded under our feet. The spectacle which struck us most was the numerous spiracles, which, either at the bottom of the crater or the interior sides of the mountain, suffer the vapours to escape. When we arrived at the crater, we were desirous to ascertain whether these vapours were of a noxious quality: we walked through them, and inspired them several times, but felt no inconvenience from them. The thermometer placed in one of these spiracles indicated 54 degrees, in another it rose only to 22. In all these experiments our instrument was covered with a humid matter, which was soon dissipated in the open air without leaving any traces.

In traversing the surface of the crater, we perceived a focus half covered by a large mass of pumice stone, and which, from its whole circumference, emitted a strong heat. The thermometer placed at first at the entrance of it, and then immersed to as great a depth as the nature of the ground and the heat would admit, never rose higher than 22 degrees. This singularity surprised us, but we were not able to explain it.

The volcanic productions which we observed in the whole crater were lava, exceedingly porous, and which the fire in certain places had reduced to scoriæ. It was of a dark brown colour, and sometimes reddish, but it is rare to find any white. The substances nearest the spiracles are all covered or impregnated with sulphur. This mineral is found very often in a state of oxygenation. It is sometimes white, and sometimes of a yellowish colour, and the sharp and pungent impression it leaves on the tongue sufficiently indicates the state in which it is. The burning focus, of which we have spoken, produces the same results. Some basaltic lava is also found, but in small quantity; one specimen only, of a considerable weight and beautiful polish, attracted our attention.

On the north side of the crater there are two large fissures, one of which is 20 feet in depth, and the other about 15. They are shaped like an inverted cone. The matter with which they are covered is entirely similar to that on the rest of the surface. They emit neither smoke nor heat; yet some sulphurous productions plainly show that the fire in these places has not long been extinct.

When we had finished these few observations, it was necessary that we should think of returning. The descent is far less laborious than the ascent; for it is difficult to climb eminences where the points of support are so moveable. Besides, people cannot ascend but one at a time in succession, after long intervals, for fear of bury-ing under a torrent of volcanic matters those who follow, as the foot, when moved, displaces the ashes, &c. to the distance of thirty feet round.

When we arrived at the two precipices, we were obliged to ascend by mounting on the shoulders of a man placed at the bottom, and laying hold of a stick held by another at the top, and to rest our feet no where but in a very gentle manner. At length, by prudence and caution, we reached the summit of Vesuvius without any accident, but exhausted with fatigue, and so covered with ashes and smoke, as to be scarcely distinguishable. Our six companions, who had not descended into the crater, were overjoyed when they saw us again, and supplied us with some refreshments, of which we had great need.

When one grand difficulty is surmounted, inferior ones are overlooked, as of little importance. In less than twenty-five minutes we again descended, having confirmed, after examining various stones, this observation, that Vesuvius is the only known volcano which throws up from its bowels primordial substances, without being altered by the fire, and such as are found at present in banks and veins.

At half after eight in the morning we arrived at Portici, the inhabitants of which were much surprised to see us return all safe. Their delicious fruits, and their excellent wine called *lacryma Christi*, soon made us forget our fatigue, and we then proceeded to Naples, which we reached in safety.

The result of this excursion, which was only an experiment, can be of no further use than to show the possibility of reaching the crater, and to open the way to it to philosophers, naturalists, and chemists, who, by exploring this immense furnace of nature at their leisure, will find a variety of matters which will afford an ample field for the application of their chemical knowledge, and may enable them to make discoveries interesting to the arts and the sciences.

The names of the eight Frenchmen, in the order in which they descended, are as follow: Debeer, secretary to the ambassador Alquier; Houdouart, chief engineer of bridges and causeways attached to the army of Italy; Wickar, painter; Dampierre, adjutant-commandant; Bagneris, physician to the army of observation; Fressinet and Andras, French travellers; and Moulin, inspector of posts.

NO. 3.

Description of the Valve Siphon of the late Mr. AMI ARGAND, *Inventor of the Lamps with a Double Current of Air.**

(With an engraving.)

THIS improvement, though simple, is ingenious, and particularly adapted to large siphons, that require to be removed from one vessel to another. A valve, as E, or H, pl. I. fig. 2, is applied to the foot of the shorter or ascending leg of a siphon AB, BC, at the other foot of which a stop cock F is placed. The cock being open, and the foot E immersed in any liquid in a vessel IK, by moving the leg E perpendicularly downward and upward, the liquid will gradually ascend through the valve E, till it runs out at the point L. The pressure of the air on the surface I will then be sufficient, to force the liquid through the valve E, as long as this remains beneath it; and thus it will continue to act as a common siphon, and the vessel will be emptied, unless supplied from some reservoir, as N.

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* Nicholson, vol. xviii. p. 61. From Sonnini's Bibliothèque Physico-économique, Nov. 1806, p. 117.

As soon as the siphon is filled, and begins to discharge the liquid at L; or at any period while it continues full; if the cock F be turned so as to stop it, it may be very safely and conveniently removed to any other vessel; as the cock will prevent the liquid from running out at one end, and the valve at the other: and the moment the extremity E is immersed in the liquid in another vessel, and the stop cock F turned, it will act again as before.

The siphon may be filled in this way in a clear liquid, and then removed into a vessel of the same kind of liquid, that has a sediment at bottom, which would be disturbed by moving it up and down. This however may not always be convenient: Mr. Argand therefore makes an aperture with a short perpendicular tube O in the horizontal branch BB, through which, by means of a funnel, D, the siphon may be filled, while the cock F is shut; so that it may be inserted into the liquid, and made to act without disturbing it. When the siphon is thus filled, or when the funnel D is not required, the aperture at O is closed by the stopple G.

For the convenience of carrying the syphon, as well as for packing it up, or cleaning it, the horizontal and perpendicular branches are made to take asunder at the joints MM. The nozzle L is likewise made to take off, as it is frequently more convenient for the fluid to be drawn off perpendicularly.

NO. 4.

V

Observations on the Various Uses to which the Sunflower may be applied. By the EDITOR.

THE advantageous employment of this plant does not appear to have been sufficiently appreciated. The object of this essay is to attract the attention of those who may have it in their power to pursue the enquiry to its full elucidation; and it is expected, that this may be readily accomplished by persons residing in the country, with little expense or trouble to themselves, and with real benefit to the community, if their experiments shall satisfactorily demonstrate the presumed merits of this very common and luxuriant product of the vegetable kingdom.

In a letter, published in the first volume of the American Philosophical Transactions, from Dr. Otto of Bethlehem to Dr. Bond, we have an account of the oil produced "from the seeds of the common large sunflower," by methods very similar to the extraction of linseed oil; one bushel of the seeds yielded about three quarts of oil; and he states that it was frequently used on sallad, for which it answered very well. The committee, to whom the specimen sent was referred, report it to be thin, clear, and agreeable to the taste, and are of opinion, that it "will supply the place of olive oil for the above, and many other purposes; and may, therefore, be looked upon as a valuable discovery to America.

Immediately following this communication, is an essay by Dr. J. Morgan, "on the expressing of oil from sunflower seed," in which we are informed, that it is found from experiments, that a bushel of the seeds will yield, on expression, near a gallon of mild oil. And he gives the account, from a correspondent at Lancaster, of certain results upon this subject, from which we learn, that one hundred plants, set about three feet distant from each other, &c. "will produce one bushel of seed, without any other trouble than that of putting the seeds into the ground, from which he thinks one gallon of oil may be made." "By an estimate made, it appears, that one acre of land will yield to the planter between forty and fifty bushels of seed, which will produce as many gallons of oil." The remainder of the essay is taken up with many valuable observations on the mode of expression, and on other points connected with the subject, which are unnecessary to be here transcribed, since the whole of the original communication will be advantageously read, by any one who finds an interest in the present essay.

Mr. John Saunders, of Gloucestershire, (England) has called the attention of the public, in Dickson's Agricultural Magazine, No. 6, to "the use of the seed of the great sunflower, (Helianthus annuus) as a food for swine, rabbits, poultry, &c." in which communication he reckons that an acre will produce from fifty to sixty sacks, (weight of sack not mentioned,) the profit of which, at the low rate of two shillings and sixpence per sack, is estimated at four pounds sterling per acre. He remarks likewise that the stems partake so much of the nature of wood, that, when perfectly dry, they may be burnt as fuel, an acre affording from three to nine waggon loads. He suggests also their use by wattling and other modes, to enclose sheep, and to guard them from the inclemencies of the weather; and that, where there are dry walls, with the aid of rafters and hurdles, they might be converted into an excellent covering for temporary sheds in the fields, and about the homesteads, for pigs and other animals. He recommends the leaves as an excellent green food for rabbits, or as serving for litter when dried. The plants, too, he affirms, will remain a long time after they are ripe, without shedding their seeds, through neglect of gathering, and are not liable to be injured by rains, or destroyed by the attacks of birds. He mentions the cultivation of the plant in France for the sole purpose of extracting an oil; and he recommends sowing the seeds very early in the spring, if not in December, as the early sown plants always arrive at the greatest height, and produce the largest quantity of seeds. The whole paper is worthy of perusal.

The mode of culture is given in the same magazine, No. 7, by "Amicus," from Dr. Willick, and Mawe and Abercrombie's Gardener's Calendar. This person states the use of the oil in *printing*; and of the *cake*, after expression of the oil, in feeding a pair of small oxen, who eat it greedily, and throve well upon two pounds a day. He further states the oil to be as fine transparent sweet oil as ever was produced from almonds; and that eighty pounds weight of clean seed produced eight quarts of oil, part of which he used in lamps, and found it burn with great pureness and brilliancy.

In No. 9 of the above mentioned magazine, a writer conceives, that it may be successfully cultivated for the purpose of supplying clothiers with oil, instead of using the Florence oil imported from the Levant, and which is sold to them when it becomes rancid, for the purpose of softening their wool, when preparing for the loom.

We have another writer on the subject in the 27th No. a Mr. John Wright, who estimates the crop produced by him at not less than twenty quarters of seed to the acre; though he considers it a tedious crop to harvest, from its ripening at so many different periods: he nevertheless appears to think well of it upon the whole.

I have thus collected a mass of facts, which altogether, I think, render this plant worthy the attention of the farmer, and afford adequate encouragement to a fair trial of its real importance, in affording a most important article to the painter, printer, clothier, and in domestic economy, both as a fuel and for diet. I come now to what, I trust, may prove of far more value in a national point of view; I mean the great strength and staple of the woody fibre of the stalk of the sunflower, a part not heretofore applied to any use, except as above proposed by Mr. Saunders.

When we consider the immense importance of the article hemp to our maritime concerns, (other objects of its application out of the question,) and recollect what sums are annually expended in Russia in the purchase of this raw material; when we reflect, too, on the comparatively small proportion of our wants supplied amongst ourselves, partly arising from the trouble and uncertainty of the crop, and more, perhaps, from other articles of husbandry being more productive; we must admit, that if a fair and adequate experiment shall prove, that a plant, attended with little trouble in cultivation, and almost certain in its produce, is capable of affording a substitute for hemp, of equal or even superior strength for manufacturing ropes, cables, &c. of such infinite importance to the commerce, &c. of the United States;—I say, if this is demonstrated by fair experiment, who will doubt its becoming an article of the first attention in agricultural pursuits? The chief object of this essay is to call upon our farmers and others, especially those who are accustomed to raise hemp, to give this a fair and candid examination. In towns, we have not adequate advantages to pursue this enquiry; but it is now several years since I accidentally found a sunflower standing in my garden, of which little remained but the woody fibre, (the rain, &c. having gradually rotted off the epidermis, &c.) which resisted so much my attempts to break it, that I was forcibly struck with the probable advantages to be derived from its use. Since that time I have repeatedly mentioned the fact, and have endeavoured to induce others to pursue the enquiry, but, I believe, without effect. My attention has been again called to this subject, by lately stripping off a small and single fibre from a plant, and twisting it once or twice into a small twine, which I could not with all my force break, otherwise than by repeatedly bending, so as gradually to destroy the cohesion of the parts; even the *single* fibre would, I believe, have supported a weight of some pounds. Under the impression I have, I consider the medium of the Emporium the best, by which I might hope to have a full and fair experiment made upon a point so truly important, and I have only to request the favour of any one who pursues it, to let me know the result, that I may communicate it to the public.

Before I conclude, I shall only add, that the *pith* of this plant, which is very considerable, is, without exception, one of the most combustible materials I know. A piece of seven or eight inches in length, from one of the branches, perfectly dry, catches fire like tinder, and burns down in less than a minute. Whether experiment may show it to be useful as a match, in blasting rocks, instead of the present kind employed, I know not; probably we may find it useful in this, as well as in other pursuits.

JOHN REDMAN COXE.

Philadelphia, October 5, 1812.

NO. 5.

Description of a New Machine for Raising Water to any height. By I. B.

(With an engraving.)

Baltimore, August 2[illegible], 1812.

SIR—If you think the machine, of which I send you the description and sketch, deserving any merit on account of its simplicity, you are welcome to make it public by means of the Emporium. Though both the principles of it are old enough, yet I never have seen them combined before.

I. B.

Dr. Coxe.

AB (plate I. fig. 1.) is a box made of thin planks, which, together with its two tubular arms BC and BD, is moveable about the centres G and H. At the extremity of each arm is a hole, as E, of such a size that the quantity of water discharged by both, shall be less than that which falls through MN: the tube AB will therefore be constantly full. H is the axis of the whole, fastened to the interior of AB. At I is a *perpetual joint*, with the upper axis of which is connected the cylinder ST, with a tube coiled round it, so as to form a screw of Archimedes. The cylinder is prevented from slipping downwards by a shoulder on its axis at *a*, and is moveable on the centres *a* and *b*.

The action of the machine, which is easily understood, is as follows: The water flows through RP, which is connected with the stream by means of a pipe, into the box X until it fills it as high as K. It then continues its course through the tube KLMN, and falls into the box AB. As the holes E and F discharge less than the quantity of water which flows into AB, it will soon become full, when the water rushing out at the two holes will cause, by its reaction, the arms, and of course the box AB, to move in a retrograde manner. The axis H revolving also turns the cylinder ST, at every revolution of which the orifice of the pipe *c* descends into the water X, takes in a small portion, and as the whole turns, raises it gradually to the top, where it is discharged at U, and carried off by the pipe W.

The cylinder may be prolonged to any height desired, but it is evident that the longer it is, the smaller must be the diameter of the tube, in order that the same force may move it in both cases.

NO. 6.

On Rail-Roads. By a CORRESPONDENT.*

To Mr. Tilloch.

SIR—As the proposed rail-way from Sanquhar to Dumfries has of late been the subject of some conversation, it is hoped the following short account of that useful invention will not be unacceptable to some of your readers.

I am, sir,
Your most obedient servant,
X. Y. Z.

Dumfries, July 2, 1811.

Rail-ways are roads of very easy inclination, having cast iron rails, on which waggons, with wheels adapted to those rails, move.

These rails are usually about three feet long, and are rested at each end on stone, wood, or cast iron.

The origin of this invention may be traced back to the year 1680. About that period, coal came to be substituted for wood as fuel in London and other places. The consequent consumption of Newcastle coal became so considerable, that the difficulty and expense of maintaining a great number of horses employed to convey the coals from the pits to the vessels, and the cost of maintaining the roads, gave rise to the introduction of waggon roads, or wooden rail-ways. On these rail-ways, a horse could draw a waggon of a large size, owing to the regular and easy descent with which the rails were laid. It was not until the year 1738 that this improvement was introduced at the Whitehaven collieries. Afterwards, attempts were made in different parts to introduce cast-iron instead of wooden rail-ways, but, owing to the great weight of the waggons then in use, these attempts did not succeed.

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* Tilloch, vol. xxxviii, p. 51

About the year 1768, a remedy was contrived for the principal objection to cast iron rail-ways; namely, the making use of several small waggons linked together, instead of one large one; thus diffusing the weight over a greater surface of the road, and consequently throwing less stress on any one part of it. Soon after the year 1797, they began to be constructed as branches to canals: since that period they have rapidly increased, and their great utility is now unquestionably established.

As on canals, *locks* are required in order to raise the vessels from a lower to a higher level, and *vice versa;* so, on rail-ways, what are called *inclined planes* are often necessary to attain the difference of level.

These inclined planes are generally, compared with the rest of the rail-way, very steep. A perpetual chain raises and lowers the waggons. It is so contrived, that the waggons disengage themselves the moment they arrive at the upper or lower extremity of the inclined plane. In some cases, the laden waggons descending serve as a power to bring up the empty ones; but where there is an ascending as well as a descending traffic on the rail-way, steam engines, water wheels, or other machines to answer the same purpose, are used. At Chapel le Frith, there is an inclined plane about 550 yards long, so that the chain extended is, of course, more than double that length.

Most rail-ways of considerable extent require the use of this species of machinery for attaining the difference of level requisite, more particularly in cases where minerals form any considerable part of the traffic. On the proposed rail-way between Glasgow and Berwick, several inclined planes will be required; the summit of that rail-way being 753 feet above the level of the end of Berwick quay.

The waggons are constructed on various plans, and are probably, in most cases, far from the degree of improvement of which they are susceptible. But, with all their disadvantages, the following facts will evince the great saving of animal force to which rail-ways gave rise.

1. With 1¼ inch per yard declivity, one horse takes downward three waggons, each containing two tons.

2. In another place, with a rise of 1$\frac{6}{10}$ inch per yard, one horse takes two tons upwards.

3. With eight feet rise in 66 yards, nearly 1¼ inch per yard, one horse takes two tons upwards.

4. On the Penrhyn rail-way, (same slope as the above,) two horses draw downwards four waggons, each containing one ton of slate.*

5. With a slope of 55 feet per mile, one horse takes 12 to 15 tons downwards, and four tons upwards, and all the empty waggons.†

6. At Ayr, one horse draws on a level five waggons, each containing a ton of coal.

7. On the Surry rail-way, one horse, on a declivity of one inch in ten feet, is said to draw thirty quarters of wheat.‡

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* See Plymley's Agricultural Report of Shropshire.

† Repertory of Arts, &c. vol. iii. 2d series.

‡ Malcolm's Agricultural Report of Surry.

Other actual cases might be given, but these will suffice to show the great saving of animal force.

From these cases, and the known laws of mechanics, we may perhaps safely infer, that where the apparatus is tolerably well constructed, and the slope ten feet per mile, one horse may draw five tons upwards, and seven tons downwards. Now, if I am rightly informed, horses at present draw from Sanquhar to Dumfries only about 9½ cwt. of coal at an average each. But say half a ton; then, on the slope stated above, *one horse* would, taking weight upward, do the work of *ten* on the turnpike road, and downward, of *fourteen*. Hence, in this point of view, it may be said that a rail-way would bring the coal mines ten times, at least, nearer to Dumfries than they are at present.

The principal rail-ways in England and Wales, a short time ago, were—the *Cardiff* and *Merthyr*, 26¾ miles long; runs very nearly by the side of the Glamorganshire canal.

The *Caermarthenshire.*—In the deep cuttings for this rail-way, several unknown veins of coal were discovered, and some of lead ore.

The *Serhowry*, twenty-eight miles, in the counties of Monmouth and Brecknock.—The *Surry*, twenty-six miles.

The *Swansey* and *Oystermouth*, 7½ miles; and many others, as branches to canals. Since these were executed, many have been added, and they are daily increasing in number.

In Scotland they have been long used about some of the coal works, and are now fast increasing. A public rail-way is now nearly completed between Kilmarnock and the Troon harbour.

No. 7.

New Method of applying the Filtering Stone for purifying Water. By Mr. WILLIAM MOULT.

(With an engraving.)

SIR—If you think the following information, relative to a new method of filtering water, is deserving of the attention of the Society of Arts, &c. I wish you would lay it before them. My objections to the old method of filtering by putting water into the filtering stone are, that the dirt falls to the bottom, and fills up, or chokes the pores of the filtering-stone, so that the stone requires frequently to be cleaned with a brush and sponge to allow the water to pass, after which the water passes through the stone in a muddy state for two or three days; it likewise requires to be frequently filled, and as it empties, less water comes into contact with the stone, and therefore a smaller quantity, in such a state, can only pass through. Likewise a filtering stone used in the common way soon becomes useless, from the filth insinuating itself into the internal parts of the stone, out of the reach of the brush.

In the method I propose and practise, the filtering-stone is placed within the water to be purified, which presses upon the outside of the filter, and the stone does not require to be supported in a frame as it needs only to stand within the water cistern; it will thus filter, in an equal time, double the quantity of water procured in the common mode; it fills itself, and requires no cleaning. I have upon this plan used one for more than three years with great success. I am, &c.

April 18, 1810. WILLIAM MOULT.

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* Nicholson, vol. xxix, p. 324. From Trans. of the Soc. of Arts, vol. xxviii, p. 212. The silver medal was voted to Mr. Moult.

CERTIFICATES.

We, the undersigned, having inspected and examined a new mode of employing the ordinary filtering-stone, discovered by William Moult, are of opinion that its superiority over the customary method is so great as to entitle it to particular notice.

That it not only supplies an infinitely greater quantity of purified and limpid water, but is capable of preserving its porosity free and pervious for years together, by an occasional self-operation.

That by this valuable process the principal objections to drip-stones is removed, viz. the constant labour they require to keep them clean by means of brushes, without eventually producing the intended effect, and without preventing their being finally rendered useless.

D'Arcy Preston, captain in the Royal Navy;
Charles Gower, M. D.;
Thomas Pitt, Esq. V. P. Wimpole street;
Richard Davenport, Esq. Wimpole street.

Reference to the Drawing of Mr. Moults Filtering Apparatus, Fig. 1, Pl. 2.

AA is the cistern containing the water to be filtered; the filtering stone B is suspended in the cistern by a ring around the inside of it, which catches the projecting part of the stone; the water in the cistern filters through into the stone. D is a siphon, which conveys the filtered water from the inside of the stone into a cistern E, which is the reservoir for clean water. *d* a cock to draw it off as it is wanted. By this mode of filtration the impurities of the water are deposited in the bottom of the cistern A, instead of being left in the bottom of the stone as in the usual mode.

No. 8.

Method of raising a loaded Cart, when the Horse in the Shafts has fallen. By Mr. BENJAMIN SMITH.*

(With an engraving.)

SIR—I have taken the liberty of sending you a model, with a brief explanation of the utility of my invention, in order that it may be laid before the Society instituted for the Encouragement of Arts, &c. to whose comprehensive judgment and abilities I with great deference submit it for their determination, whether they think it likely to be attended with the success and utility which I flatter myself it deserves. From the simplicity of the construction and the trivial expense attending it, I presume there will be no bar to its universal adoption. I respectfully submit it to the discernment and decision of the society, who will, I am convinced, give it all the merit and approbation it may deserve.

The reason which prompted me to undertake this business is from having seen a horse, which had fallen down under the immense weight of a heavy loaded cart, where it lay for a considerable time in that painful and dangerous situation, which naturally excited compassion even in the most obdurate heart. Every person frequenting the streets of this metropolis must have witnessed similar scenes; and indeed it surprises me, that long before now some expedients have not been publicly suggested to remove the mischief arising from such occurrences, considering the great encouragement that is given in this enlightened age to all useful improvements.

Having conversed on this subject with persons who possess considerable knowledge of horses, and who constantly employ these noble animals, I find, that horses remaining so long as they usually do in such improper positions, and from being often dragged a considerable distance by fruitless endeavours to raise them, are much endangered in their health and lives, and that their situation upon the stones is more prejudicial than the injury received by the fall.

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* Nicholson, vol. xxix, p. 326. From Trans. of Soc. of Arts, vol. xxviii, p. 215. [illegible] guineas were voted to Mr. Smith.

I flatter myself that my method will be found to raise the whole weight of the cart, and a considerable part of that of the horse, in the short space of three or four minutes from the moment of the accident, by means simple and useful, and within the reach of the meanest capacity to execute; and that the whole apparatus will not cost above fifty shillings, and will last many years. Requesting your kind attention,

I am, Sir,
Your most obedient servant,
BENJAMIN SMITH.

London, December 13, 1809.

Advantages derivable from this Invention.

1.—The invention is of itself so simple, and the operation so conspicuous at the first view, that the whole process may be easily comprehended and executed.

2.—The apparatus may be fitted with little difficulty to any cart now in use for heavy loads, such as bricks, coals, corn, or the like.

3.—The chains, which lead from the uprights at the back part of the cart to the fore part of it on each side, are for the purpose of taking the purchase therefrom, and making the back part of the cart act as a lever at the time the horses are drawing behind, which, without fail, with the strength of one, two, or three horses fastened there to raise the one which is down in the shafts, will instantly assist him to get upon his feet.

4.—The number of horses to draw a cart are usually in proportion to the weight contained therein; therefore supposing three horses are employed to draw it, and the shaft horse falls, the carman has only to unhook the two leaders, and then hook them to the short chain at each side of the back of the cart, and with their strength the fallen horse will be so relieved from the weight, as to raise himself without farther assistance.

5.—The same principle may be applied in different ways from what I have shown in the model; for instance, another mode may be adopted by framing the tail board of the cart strong enough to bear the purchase; and, with the use of the two side chains above mentioned, it may be made to answer the purpose.

Another plan, though more expensive, is by obtaining two wrought iron uprights to be fixed as substitutes for the truss staffs at the back part of the cart, with a hole in the top of each to receive an iron rod, which is occasionally to be introduced, reaching from one side of the cart to the other, connecting the two uprights together; when in action the two side chains to be used as in other cases.

Reference to the Drawing of Mr. Smith's Method of raising up a Horse when fallen down in the Shafts of a loaded Cart, Fig. 2, Pl. 2.

A is the wheel, and B the shafts of a cart, such as is used in London; C the side rails; at the end of the body an iron stancheon or truss staff, *a*, is fixed by the hinge at the lower end, and at the upper end it is supported by a chain *b*, extended from the fore part of the body of the cart; this diagonal chain forms a firm support to the stancheon. This is all the addition made to the common cart, and is used in the event of the shaft horse falling, by hooking the traces of the other horses to a chain *d*, also fixed to the stancheon; the power of these horses, applied at this height above the fulcrum, will have a great purchase to elevate the shafts, and set the fallen horse at liberty, as is evident from an inspection of the figure. The stancheon moves on a joint on its lower end, and the oblique chain unhooks at *b*; the end can be connected with a short piece of chain *e* fastened to the last of the side rails; the stancheon now takes the position of the dotted lines *f*, and the short chain, which hangs down perpendicular from the end of it, may be taken hold of by any number of men, to weigh upon and raise the cart in cases where the horses cannot conveniently be applied; the men will in this manner have much greater effect than merely (as is the common practice) weighing on the hind part of the cart.

When the chain is completely detached, and the stancheon suffered to hang down perpendicularly, it forms a prop to support the cart steady while it is unloaded. It should be observed, that, though only one stancheon appears in the figure, there are in fact two, one being placed on each side of the cart.

CERTIFICATE.

Mr. William Whitehead, jun. of Cadogan place, Sloane street, certified, that he had attended experiments made to ascertain the efficacy of Mr. Smith's invention; that a cart weighing twenty-three hundred weight, loaded with one ton of stones, was raised by means of Mr. Smith's apparatus with ease by one horse.

That he very much approves of Mr. Smith's invention, and thinks it likely to be of great service in general practice, more especially on account of the business being effected with little expense. That many carts are already so formed, that very little additional apparatus will be required to complete them for the purpose.

No. 9.

Description of a very cheap Engine for raising Water. In a Letter from Mr. H. SARJEANT *of Whitehaven, to Mr.* TAYLOR, *Secretary to the Society for the Encouragement of Arts.**

(With an engraving.)

SIR—I am sensible that the little engine, a drawing of which accompanies this letter, can lay no great claim to novelty in its principle; nevertheless it is respectfully submitted to the consideration of the society, how far its simplicity, and cheapness of construction, may render it worthy of their attention, with a view to its being more generally known and used in similar cases.

Irton Hall, the seat of E. L. Irton, Esq. is situated on an ascent of sixty or sixty-one feet perpendicular height; at the foot of which, at the distance of about one hundred and forty yards from the offices, runs a small stream of water. The object was to raise this to the house for domestic purposes.

To this end a dam was made at a short distance above, so as to cause a fall of about four feet; and the water was brought by a wooden trough, into which was inserted a piece of two-inch leaden pipe, a part of which is seen at A, plate 2, fig. 3.

The stream of this pipe is so directed as to run into the bucket B, when the bucket is elevated; but so soon as it begins to descend, the stream flows over it, and goes to supply the wooden trough or well in which the foot of the forcing pump C stands, of three inches bore.

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* Nicholson, vol. ii, p. 60. From the Transactions of the Society, for 1801, p. 255. The silver medal was given to the Inventor.

D, is an iron cylinder attached to the pump rod, which passes through it. It is filled with lead, and weighs about two hundred and forty pounds. This is the power which works the pump, and forces the water through four hundred and twenty feet of inch pipe from the pump up to the house.

At E is fixed a cord which, when the bucket comes to within four or five inches of its lowest projection, becomes stretched and opens a valve in the bottom of it, through which the water empties itself.

I beg leave to add, that an engine, in a great degree similar to this, was erected some years ago by the late James Spedding, esquire, for a lead mine near Keswick, with the addition of a smaller bucket which emptied itself into the larger, near the beginning of its descent, without which addition it was found that the beam only acquired a libratory motion, without making a full and effective stroke.

To answer this purpose in a more simple way, I constructed the small engine in such manner as to finish its stroke (speaking of the bucket end,) when the beam comes into an horizontal position, or a little below it. By this means the lever is virtually lengthened in its descent in the proportion of the radius to the cosine, of about thirty degrees, or as seven to six nearly, and consequently its power is increased in an equal proportion.

It is evident that the opening of the valve might have been effected, perhaps better, by a projecting pin at the bottom; but I chose to give an exact description of the engine as it stands. It has now been six months in use, and completely answers the purpose intended.

The only artists employed, except the plumber, were a country blacksmith and carpenter; and the whole cost, exclusive of the pump and pipes, did not amount to five pounds. I am, &c.

H. SARJEANT.

Warwick Court, Holborn.
Mr. Charles Taylor.

In another letter, dated Whitehaven, April 28, 1801, Mr. Sarjeant further observes that the pump requires about eighteen gallons of water in the bucket to raise the counter-weight, and make a fresh stroke in the pump; that it makes three strokes in a minute, and gives about a half gallon into the cistern at each stroke. He adds, "I speak of what it did in the driest part of last summer; when it supplied a large family, together with work people, &c. with water for all purposes, in a situation where none was to be had before, except some bad water from a common pump which had been since removed. But the above supply being more than sufficient, the machine is occasionally stopped to prevent wear, which is done by merely casting off the string of the bucket valve."

No. 10.

On curing British White Herrings in the Dutch method. By Francis Fortune, *Esq.**

Being desirous that the greatest degree of publicity should be given to every particular relative to the manner in which the Dutch were used to cure their herrings; and being aware of the extensive circulation of the Transactions of the Society for the Encouragement of Arts, &c. I feel anxious that a communication likely to be referred to by so many for information, should be intelligible and satisfactory. Under these impressions, and observing that the Society desire "that papers sent to them should be full, clear, and explicit," rather in the form of essays than of letters, I have stated more than perhaps may appear at first sight absolutely necessary, but I flatter myself not more than may prove really useful.

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* Repertory, No. 122, second series, p. 124. From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

In the deep sea (which is the principal fishery for herrings) the nets are cast from the busses by sunset, and they drive by them alone expecting the shoals, the approach of which is generally indicated by small quantities of fish; and their arrival by immense flights of sea fowl. The best fishing is with the wind off shore, for, when it blows in a contrary direction, the shoals are broken and dispersed, and the fishery is seldom successful while it continues in that point.

Immediately after the nets are hauled in, (which is often performed with considerable difficulty, by means of a windlass, when they are full,) the crew begin to gyp the fish, that is, to cut out the gill, which is followed by the float or swin, and divide the large jugular or spiral vein with a knife at the same time, endeavouring to waste as little of the blood as possible;—at this work the men are so expert, that some will gyp fifty in a minute.

Immediately after they are gypped, they are put into barrels, commencing with a layer of salt at the bottom, then a tier of fish, each side by side, back downwards, the tail of one touching the head of the other, next a layer of salt, and so alternately until the barrel is filled; they are thus left, and the blood which issues from the fish, by dissolving the salt forms a pickle infinitely superior to any other that can be made. The herrings thus drained of their blood occupy less space, and the whole consequently sinks about one-third down the barrel, but this sinking is at end in about three or four days.

When these operations are being performed, the sea is often running mountains high; and it is not therefore to be supposed, that the barrels are so well coopered as not sometimes to allow the pickle to leak out; and in order to preserve the fish from being spoiled, which would otherwise happen in such cases, some of the gills and entrails are always put by in barrels with salt, in the same manner as the herrings, and yield a pickle of the same quality; with this pickle those barrels which have leaked are replenished, and the fish sustains no injury. Every operation is performed in the shade, into which the fish are immediately conveyed, on their being hauled on board. Each day's fishing is kept separate with the greatest care. The salt used is mixed, and of three different sorts, *viz.* English, St. Ubes, and Alicant, and each barrel marked with the date of the month on it on which it was filled.

The advantages of gypping the herrings are, that the blood which issues in consequence of the operation from the fish, yields a natural pickle, and improves the flavour; whereas, if left in the fish, it becomes coagulated at the back bone, and forms the first cause of decay. The mixture of blood and salt operated upon by the extreme heat of the weather during the summer fisheries, produces a fermentation which nearly parboils the herrings, and removes the coarse and raw flavour so often complained of. The gypping is likewise often performed on shore, observing the same precautions; the only difference is, that they are seldom in that case of so good a colour. Gypped herrings are never of so fine a quality as when kept in their own original pickle; their value consists in their softness and flavour; it is this mode of curing herrings that used to be the pride of the Dutch, and this is the kind which supplied their home consumption, and were so much esteemed by all classes of people in Holland.

In order, as far as is possible, to give a proof of the correctness of the above assertion, I shall state a fact for the information of the Society. During the last year, I employed a number of Dutch fishermen, prisoners, and others, with Englishmen, in gypping and curing herrings; and at one time, my agent at Yarmouth was offered four pounds per barrel for all the herrings he had cured there, by a Dutch captain, in order to their being taken to Holland, while ungypped herrings were worth only thirty-six shillings per barrel. The herrings now under consideration of your Society, are part of the quantity for which that offer was made.

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NO. 11.

Report made to the Institute on a Memoir, by M. Tarry, *on the Composition of Writing Ink. By Messrs.* BERTHOLLET, VAUQUELIN, *and* DEYEUX.*

THE object proposed by M. Tarry in his memoir is to explain:

1. The processes employed for discharging writing from paper.

2. The processes for reviving writings which have been apparently obliterated.

3. The best way to improve common ink.

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* Tilloch, vol. xxxviii, p. 34. From Annales de Chimie, tome lxxv, p. 194.

4. Finally, the discovery of an ink which should resist all chemical agents.

We shall now give an abridgement of these four articles:

ARTICLE I.

Processes for Discharging Writing.

The art of discharging writing is very ancient, and the means employed are very simple. In fact, we know that it is sufficient to moisten a written paper with any acid, when the writing will gradually disappear. But all the acids cannot be employed with equal success. Some leave a stain on the paper which is not easily removed: others corrode and render the paper unserviceable. The way to avoid these inconveniences is to make choice of an acid which shall act on the writing only, without injuring the paper or giving it a colour different from that which it had before it was written upon.

In order to discover such of the acids as are best suited for the operation in question, the author determined to submit common writing ink to the action of different acids, and to observe carefully the phenomena which these bodies present at the time of their mixture. According to him, the sulphuric acid easily takes out writing, but at the same time it gives an oily tint to the paper.

The acid oxalate of potash produces more certain and more prompt effects. The oxygenized muriatic acid, if it be newly made, seems to be preferable to the above two acids, because at the same time that it takes out the writing it bleaches the paper without altering it.

It is not the same case with the nitric acid, which always takes out the ink, but soon penetrates the paper and forms above it undulated lines of a yellow colour.

We may succeed, however, in softening both these effects, by taking the precaution to dilute the nitric acid with a sufficient quantity of water, or to wash the paper immediately after the writing has been taken out.

A mixture of the muriatic and nitric acids has but a slow action upon writing. It bleaches the paper and does not oppose its desiccation, as when we employ the nitric acid alone.

In general, whatever be the kind of acid employed to discharge writing, it is always proper when the operation is performed to dip the paper in water, in order to dissolve the new combinations which the acids have formed with the particles of ink which have been discharged.

M. Tarry, at the conclusion of this article, does not fail to observe that China ink does not act like common ink with the acids, as its composition is quite different from that which we use for writing of all kinds. So far from the acids attacking China ink, they make it, on the contrary, of a deep black: it cannot be discharged therefore without erasing it.

ARTICLE II.

Processes for ascertaining what Writing has been substituted for something taken out, and Methods of reviving the Writing which has disappeared.

All the methods which have been given for discharging writing consist, as abovementioned, in decomposing the ink and in forcing its constituent parts to form other combinations. These combinations, being decomposed in their turn by different agents, may regain a tint, which, if it be not that of ink, at least exhibits a shade which becomes perceptible enough for ascertaining the letters and words which had been traced on the paper before it was touched by the acids.

The gallic acid is, according to the author, one of those agents, which in this case succeeds very well.

The liquid prussiate of lime also produces a good effect.

It is the same case with the alkaline hydrogenated sulphurets. But it is very certain that we never obtain any success from the employment of these agents, when we have left any acid long in contact with the writing, and particularly if we have washed the paper afterwards.

In short, we may easily conceive, that in this case the constituent parts of the ink which were combined with the acid, and had formed with it compounds soluble in water, having been taken up by this fluid, ought not to leave any trace of their existence longer; and consequently it is impossible that the agents employed for discovering them can render them visible.

It is also for this reason that the gallic acid, the liquid prussiate of lime, the alkaline hydrogenated sulphurets, and so many other reagents which have been so much praised, can no longer be regarded as infallible methods for reviving writing.

ARTICLE III.

Improvement of Common Ink.

Most of the inks now in use are of a bad quality. Some are spontaneously destroyed; others imperceptibly lose their black colour, and assume a yellow one; several, after a length of time, enter into the paper, and spoil it:

lastly, there are some which are first pale and then become very black.

All these differences arise from the nature of the substances which have been employed in the making of the ink.

Convinced of the advantage of having a good article of this kind, the author commenced a series of experiments, but is forced to admit that he has not discovered any receipt superior to that which has been published by Lewis. This ink, according to our author, combines every advantage: but we must observe that it is no more exempt than the rest from being dissolved in the acids, and in this respect it has an inconvenience which those who wish to discharge writing from paper know very well how to profit by. This circumstance, no doubt, induced M. Tarry to make some new experiments in order to obtain an ink which should be inalterable by chemical agents; and he appears to us to have succeeded in his object.

ARTICLE IV.

Discovery of an Ink which resists the Action of Chemical Agents.

The author describes his invention in the following words:

"My ink is founded upon principles different from those of all others. It contains neither gall nuts, Brazil wood, or Campeachy, gum, nor any preparation of iron: it is purely vegetable, resists the action of the most powerful vegetables, the most highly concentrated alkaline solutions, and, finally, all the solvents.

"The nitric acid acts very feebly upon the writing performed with this ink. The oxymuriatic acid makes it assume the colour of pigeon's dung. After the action of this last acid, the caustic alkaline solutions reduce it to the colour of carburet of iron: the characters of the writing nevertheless remain without alteration, and it cannot pass through these different states except after long macerations. The principles of which it is composed render it incorruptible, and it can retain its properties many years."

The results which we obtained, coincided entirely with those of the author, and we have no hesitation in saying, that his is the best we have ever seen of the kind which is called indelible ink. It is liable, however, to deposit a sediment, a disadvantage which we think might be removed by M. Tarry after a few more experiments. We have tried to discharge it with all the known chemical agents, but without effect; and we think the inventor deserves the thanks of the Institute, and of the community at large.*

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* It may, perhaps, be acceptable to our readers to have Dr. Lewis's receipt given in this place. His observations are to be found at large in the Commerce of Arts.

"Put into a stone or glass bottle, or any other vessel, three ounces of finely powdered galls, one ounce of green vitriol, one ounce of logwood, finely rasped or bruised, one ounce of gum arabic, and a quart of soft water. Shake the bottle well, and let the ingredients stand in a moderately warm place for a week or ten days, shaking it frequently in the day. It is then fit for use; but a little before it is put into the ink-stand, it is better to shake the bottle that the colour may be more uniformly diffused."

I have tried this and various other receipts for ink; but after an experience of several years, I prefer the following, by Mr. Ribancourt, from Chem. Annal. vol. ii.

"Eight ounces of galls, and four ounces of logwood, are boiled with twelve pounds of water for an hour, or till one half of its quantity is evaporated. This liquor is then percolated through a hair sieve, and four ounces of vitriol, or sulphate of iron, three ounces of gum arabic, one ounce of copperas or sulphate of copper, (so in the copy,) and one ounce of sugar candy, are added. The whole mass is stirred to promote the solution of the salts and gum, after which it is left to stand for twenty-four hours. The liquid is then poured off from its coarse sediment, and preserved in well stopped glass or stone jars. This ink acquires a beautiful black colour, which it retains for a long time."

It is to be regretted that Mr. Tarry has not given us the receipt for his ink, which such celebrated chemists as the authors of the above report, speak so highly of. EDITOR.

No. 12.

Extract from a Memoir on Vegetable and Animal Analysis. By M. M. Gay Lussac *and* Thenard.*

When we had conceived the project of analysing animal and vegetable matters, the first consideration which presented itself to our serious attention was to transform, by means of oxygen, the vegetable and animal substances into water, carbonic acid, and azote. It was evident that if we could succeed in operating the transformation so as to collect all the gases, this analysis would be accomplished with very great precision and simplicity. Two obstacles presented themselves: one was to burn completely the hydrogen and the carbon of these substances, and the other to operate the combustion in close vessels.

We could expect to surmount the first difficulty only by means of the metallic oxydes which easily give up their oxygen, or by the hyper-oxygenated muriate of potash. Some experiments soon made us give the preference to the above salt, which succeeded beyond all expectation. It was not quite so easy, however, to overcome the latter difficulty; for we could not attempt combustion in a retort full of mercury. To prevent the matter from being burnt, the retort must have been broken: it became necessary to find an apparatus, therefore, in which we might—

1. Burn portions of substance so small as not to fracture the vessels.
2. To make a great number of successive combustions, in order that the results might be perceptible.
3. To collect the gases as they were formed.

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* Tilloch, vol. 38, p. 60. From Annales de Chimie, tome 74, p. 47.

We now exhibit to the class* an apparatus of the above description. It is formed of three distinct pieces: one is a very thick glass tube, closed at its lower extremity by the blow-pipe, and open at its upper end, about two decimetres in length, and eight millimetres in breadth; it has laterally, five centimetres from its aperture, a very small tube also of glass, which is soldered to it, and which resembles that which we should adapt to a retort for receiving the gases. The other piece is a copper ferule into which we insert the open extremity of the large glass tube, and with which it is united by means of a mastic which melts only at forty degrees. The last piece is a peculiar kind of stopcock, in which the whole merit of the apparatus consists. The key of this stopcock has no hole through it, and turns in every direction without giving vent to the air: there is simply about the middle of it a cavity capable of receiving a small pea: but this cavity is such that being in its upper position, it corresponds to a small vertical funnel which penetrates the socket, and of which it forms in some measure the extremity of the beak, and which when brought back to its lower position communicates with, and is a continuation of, the body of the stopcock, which is hollow, and is screwed to the ferule. Thus, when we put small fragments of any matter into the funnel and turn the key, the cavity is soon filled, and carries the matter into the body of the stopcock, from which it falls into the ferule, and from thence to the bottom of the glass tube.

If this substance, therefore, be a mixture of hyper-oxygenated muriate of potash and of vegetable substance in proper proportions, and if the lower part of the glass tube be sufficiently warm, it will briskly take fire: the vegetable substance will then be instantaneously destroyed and transformed into water and carbonic acid, which will be collected over mercury with the oxygen gas issuing by the small lateral tube.

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* Of the National Institute. EDITOR.

In order to execute this operation easily, we may conceive that it is necessary that the matter be detached entirely from the cavity and fall to the bottom of the tube. For this purpose it is made up into small balls, as will be mentioned presently: we may also conceive that it is necessary to inquire what is the proper quantity of hyper-oxygenated muriate for burning completely vegetable substance. We must even take the precaution to employ at least one half more than this substance requires, in order that the combustion may be complete.

But of all the inquiries which ought to precede the operation, the most important is the analysis of the hyper-oxygenated muriate employed; for upon this all the calculations of the experiments are in a great measure founded.

All this being well understood, it will be easy to analyse a vegetable substance with the hyper-oxygenated muriate. The substance is to be ground on a porphyry slab with the greatest care, as also the hyper oxygenated muriate; quantities of both are to be weighed in very accurate scales; they are to be well mixed, moistened, and rolled into cylinders; these are to be divided into small balls, which are to be exposed to a boiling heat in order to render them as dry as the original materials were. If the substance to be analysed is a vegetable acid, it is to be combined with lime or barytes before mixing it with the hyper-oxygenated muriate: the salt which results is to be analysed, and an account is to be taken of the carbonic acid which remains united to the base after the experiment: lastly, if the substance to be analysed contains some bodies which are foreign to its nature, they are also to be taken account of.

Thus we know accurately that a given weight of this mixture represents a known weight of hyper-oxygenated muriate, and of the substance which we wish to analyse.

Now in order to finish the operation, nothing more is requisite than to make the bottom of the tube red hot: to drive off all the air by means of a certain number of balls, which we do not weigh, and which we throw in one after another; then to decompose in the same manner a weight of them precisely determined, and carefully to collect all the gases in flasks full of mercury and gauged beforehand.

If all the flasks are of the same capacity, they will be filled with gas by equal weights of mixture; and if we examine these gases, we shall find them perfectly identical, an evident proof of the extreme accuracy of this method of analysis.

The tube ought to be kept during the whole operation at the highest degree of heat which it can support without melting, in order that the gases may not contain any oxy-carburetted hydrogen gas. In all cases the analysis ought to be performed over mercury. This is a proof to which it is indispensable to subject them: for this purpose it is sufficient to mix them with one fourth of their volume of hydrogen, and to pass an electric spark into them. As they contain a great excess of oxygen, the hydrogen which we add, and of which an account must be kept, burns as well as the whole oxy-carburetted hydrogen which they may contain; and we thus acquire the certainty that they are no longer formed of any thing but carbonic acid and oxygen, which must be separated by potash.

But this necessity of raising the temperature obliges us on the other hand to take some precautions in order that the stopcock may not be heated. With this view the glass tube is passed through a brick to which it is fastened with clay, and which at the same time gives solidity to the apparatus: besides this, we must solder to the body of the stopcock a small hollow cylinder in which water is put, or rather ice.

We have thus all the necessary data for knowing the proportion of the principles of the vegetable substance: we know how much of this substance has been burnt, since we have the weight of it to a demi-milligramme: we know how much oxygen is wanted to transform it into water and into carbonic acid, since the quantity of it is given by the difference which exists between that contained in the hyper-oxygenated muriate and that contained in the gases: lastly, we know how much carbonic acid is formed, and we calculate how much water ought to be formed.

By following the same order of analysis, we also succeed in determining the proportion of the constituent principles of all the animal substances. But as these substances contain azote, and as there would be a formation of nitrous acid gas, if we employed an excess of hyper-oxygenated muriate in order to burn them, we need only employ a quantity sufficient for reducing them completely into carbonic acid gas, oxy-carburetted hydrogen, and azote, of which we perform the analysis in the eudiometer with mercury by the common methods, and from which we may conclude exactly that of the animal substance itself.

The method in which we proceed to the analysis of vegetable and animal substances being exactly known, we can tell what quantity of it we decompose without any fear of weakening the confidence which we ought to have in our results. This quantity rises at most to six decigrammes: besides, if there was the smallest doubt as to their exactness, we could get rid of it upon recollecting that we fill successively with gas, two and sometimes three flasks of the same capacity; that these gases are identical, and always proceed from one and the same weight of materials.

We might add, that the exactness of any analysis consists rather in the accuracy of the instruments, and of the methods which we employ, than in the quantity of matter upon which we operate. The analysis of the air is more exact than any analysis of the salts, and yet it is performed upon two or three hundred times less matter than the latter. This is because in the former, where we judge of weights by volumes which are very considerable, the errors which we may commit are perhaps one thousand or twelve hundred times less perceptible than in the latter, where we are deprived of this resource. Now as we transform into gas the substances which we analyse, we bring our analyses not only to the certainty of the common mineral analyses, but to that of the most precise mineral analyses: more particularly as we collect at least a litre of gas, and as we find even in our way of proceeding the proof of an extreme exactitude and of the most trifling errors.

We have already methodically analysed, with all the precautions just mentioned, sixteen vegetable substances; viz. the oxalic, tartarous, mucous, citric, and acetic acids; turpentine in resin; copal, wax, olive oil; sugar, gum, starch, sugar of milk, oak and ash wood, and the crystallizable principle of manna. The results which we obtained seem to us to be of the first rate importance, for they led to three very remarkable laws to which the composition of vegetables is subjected, and which may be thus expressed:

First Law.

A vegetable substance is always acid when the oxygen is to the hydrogen in a greater proportion than in water.

SECOND LAW.

A vegetable substance is always resinous, oily, or alcoholic, &c. when the oxygen is in a less proportion to the hydrogen than in water.

THIRD LAW.

Lastly, a vegetable substance is neither acid nor resinous, and is analogous to sugar, gum, starch, sugar of milk, to the ligneous fibre, to the crystallizable principle of manna when the oxygen is in the same proportion as in water.

Thus, supposing for a moment that hydrogen and oxygen were in the state of water in vegetable substances, which we are far from thinking is the case, the vegetable acids would be formed of carbon, water and oxygen in various proportions.

The resins, the fixed and volatile oils, alcohol and ether, would be formed of carbon, water and hydrogen, also in various proportions.

Lastly, sugar, gum, starch, sugar of milk, the ligneous fibre, the crystallizable principle of manna, would only be formed of carbon and water, and would only differ in the greater or less quantities which they contained.

This may be shown by citing various analyses of acid and resinous substances, and of substances which are neither acid nor resinous.

One hundred parts of oxalic acid contain:

Carbon	26.566
Oxygen	70.689
Hydrogen	2.745
	100

Or, rather

Carbon	26.566
Oxygen and hydrogen in the proportions in which they exist in water.	22.872
Oxygen in excess .	50.562
	100

One hundred parts of acetic acid contain:

Carbon	50.224
Oxygen	44.147
Hydrogen	5.629
	100

Or, rather:

Carbon	50.224
Oxygen and hydrogen in the proportions in which they exist in water	46.911
Oxygen in excess ,	2.865
	100

The oxalic acid contains, therefore, more than half its weight of oxygen in excess, in proportion to the hydrogen, whereas in the acetic acid this excess is not quite three centiemes.

These two acids occupy the extremes of the series of the vegetable acids: of all the acids the one is the most, and the other is on the contrary the least oxygenated: this is the reason why it requires so much nitric acid to convert sugar and gum, &c. into oxalic acid; and this is the reason, on the contrary, that so many vegetable and animal substances produce so easily acetic acid in a great many circumstances, and that wine in particular is changed into vinegar without any intermediate acid being formed; a phenomenon which had not been hitherto explained, because vinegar has been regarded as the most highly oxygenated of all the acids.

One hundred parts of common resin contain:

Carbon	75.944
Hydrogen and oxygen in the proportions in which they exist in water	15.156
Hydrogen in excess	8.900
	100

One hundred parts of olive oil contain:

Carbon	77.213
Hydrogen and oxygen in the proportions in which they exist in water	10.712
Hydrogen in excess	12.075
	100

One hundred parts of crystallized sugar contain:

Carbon	40.704	Or, rather	Carbon	40.194
Oxygen	52.101		Hydrogen and oxygen in the proportions in which they are in water	59.806
Hydrogen	7.105		Oxygen in excess	0.
	100		Hydrogen in excess	0.
				100

One hundred parts of ash wood contain:

Carbon	51.192	Or, rather	Carbon	51.192
Oxygen	42.951		Hydrogen and oxygen in the proportions in which they are in water	48.808
Hydrogen	5.857		Oxygen in excess	0.
	100		Hydrogen in excess	0.
				100

These results prove a very important fact: viz. that water *per se* or its principles are seized upon by the vegetable in the act of vegetation; for, all the vegetables being almost entirely formed of ligneous fibres and mucilage, which contain oxygen and hydrogen in the same proportions as water, it is evident that when carried into the substance of the vegetable it is then combined with carbon in order to form them.

If, therefore, it were in our power to unite these two bodies in every given proportion, and to bring their molecules together in a proper manner, we should certainly make all the vegetables which hold the middle rank between the acids and the resins, such as sugar, starch, the ligneous fibres, &c.

Among the animal substances we have only as yet analysed fibrine, albumen, gelatine, and the caseous substance.

It results from our analyses, that in these four substances, and probably in all analogous animal substances, the hydrogen is in a greater proportion to the oxygen than in water; that the greater the excess of hydrogen, the greater is the quantity of azote which they contain also; that these two quantities are almost both in the same proportion as in ammonia, and that it is probable that this proportion, which we nearly approach, does actually exist: the more, probably, because we always find a little too much hydrogen, and as all the errors which we can make tend to increase the quantity of it. We shall judge of this by the two following analyses.

One hundred parts of fibrine contain:

Carbon	51.675
Hydrogen and oxygen in the proportion in which they exist in water	26.607
Hydrogen in excess	5.387
Azote	16.331
	100

One hundred parts of caseous matter contain:

Carbon	57.190
Hydrogen and oxygen in the proportion in which they exist in water	18.778
Hydrogen in excess	5.680
Azote	18.352
	100

Admitting this report to be correct, these substances would correspond, with respect to the rank which they ought to hold among the animal substances, to the rank occupied by sugar, gum, ligneous fibre, &c. among the vegetable substances: for in the same way as hydrogen and oxygen, the gaseous principles of the former, may be reciprocally saturated and form water; in the same way hydrogen, oxygen and azote, the gaseous principles of the latter, may be also reciprocally saturated and form water and ammonia: so that the carbon, which is the only fixed principle which all of them contain, does not possess any property relative to that saturation. If we are guided by analogy, we might compare under this point of view the animal acids with the vegetable acids, and the animal fats (if there are any which contain azote) with the resins and vegetable oils: consequently the hydrogen could not be in a sufficient quantity in the uric acid, for satuating the oxygen and azote which this acid contains, or to form water and ammonia by combining with these two bodies, and the contrary would take place in the animal fats. A numerous train of consequences may certainly be drawn from all the preceding results; but we shall defer the further consideration of the subject till a future occasion.

NO. 13.

On preserving Fresh Water sweet during long Voyages.

By SAMUEL BENTHAM, *Esquire.*[*]

THE Society for the Encouragement of Arts, &c. having thought proper to offer a premium in order to ascertain, for the use of the public, the best mode of preserving fresh water sweet at sea, I request you to lay before the Society an account of the method which I have employed for this purpose on board two ships, and which has been attended with all the success that can be reasonably expected.

The mode in which I conceived fresh water might be preserved sweet, was merely by keeping it in vessels of which the interior lining at least should be of such a substance as should not be acted upon by the water, so as to become a cause of contamination. Accordingly, on board the two ships here alluded to, the greater part of the water was kept, not in casks, but in cases or tanks, which, though they were made of wood, on account of strength, were lined with metallic plates, of the kind manufactured by Mr. Charles Wyatt, of Bridge street, under the denomination of tinned copper sheets; and the junctures of the plates or sheets were soldered together, so that the tightness of the cases depended entirely on the lining, the water having no where access to the wood. The shape of these cases was adapted to that of the hold of the ship, some of them being made to fit close under the platform, by which means the quantity of water stowed was considerably greater than could have been stowed, in the same space, by means of casks; and thereby the stowage room on board ship was very much increased.

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[*] Tilloch, vol. 12, p. 12. From the Transactions of the Society of Arts, &c. Adelphi. London, for 1801.—The Society awarded their gold medal to Mr. Bentham for this communication.

The quantity of water kept in this manner on board each ship was about forty tuns, divided into sixteen tanks; and there was likewise on board each of the ships about thirty tons stowed in casks as usual.

As the stowing the water in tanks was considered as an experiment, the water in the casks was used in preference; that in the tanks being reserved for occasions of necessity, excepting that a small quantity of it was used occasionally for the purpose of ascertaining its purity, or when the water in the casks was deemed, when compared with that in the tanks, too bad for use.

The water in thirteen of the tanks on board one ship, and in all the tanks on board of the other, was always as sweet as when first taken from the source; but in the other three of the tanks on board one ship, the water was found to be more or less tainted as in the casks. This difference, however, is easily accounted for, by supposing that the water of these tanks was contaminated before it was put into them; for in fact the whole of the water was brought on board in casks for the purpose of filling the tanks, and no particular care was taken to taste the water at the time of taking it on board.

After the water, kept in this manner, had remained on board a length of time which was deemed sufficient for experiment, it was used out, and the tanks were replenished as occasion required: but in some of the tanks, on board one ship at least, the original water had remained three years and a half, as appears by the certificates herewith inclosed. About twenty-five gallons of the water, which had remained this length of time in the ship, are sent to the Society, in two vessels made of the same sort of tinned copper with which the tanks were lined. I am, &c.

SAMUEL BENTHAM.

MR. TAYLOR.

A certificate from captain William Bolton, commander of the said vessel, dated Sheerness, 28th of June 1800, accompanied this letter, stating, that the water delivered to the Society was taken from a tank holding about seven hundred gallons, and which his predecessor, captain Portlock, had informed him had been poured into this tank in December 1796, except about thirty gallons added in 1798, and had remained good during the whole time.

The signatures to the above accounts were certified on the 28th of June 1800, by the reverend C. Thee, minister of Sheerness.

In a letter dated January 27, general Bentham also states, that the water which had been preserved sweet on board his majesty's sloops Arrow and Dart, and of which he had sent specimens to the Society, was taken from the well at the king's brewhouse at Weevil, from whence ships of war lying at or near Portsmouth are usually supplied with water for their sea store, as well as for present use.

NO. 14.

Recipe for an elastic and permanent Varnish for Hats or Helmets of Felt, Gaiters, or other Parts of Dress in Leather, as Boots and Shoes, and which may be also employed with Success in varnishing Cloth and Linen.[*]

First Operation.—It is necessary, in the first place, to free the hats, or other articles of felt, from all the gum which they may contain. This may be easily effected by washing them in warm water, and afterwards pressing them. Before they are perfectly dry, they must be placed on moulds in order that they may be preserved in their proper shape, and be without wrinkles,—a very essential requisite. New leather, as well as old, must be scraped in order to clear its superficies from the wax or grease with which it is impregnated. Colophony, or resin in powder, laid upon a coarse brush, also removes the grease perfectly well.

Second Operation.—All felt hats have a kind of down or nap, of which they must be cleared, when dry, by means of pumice stone; and every part of the hat where the varnish is to be applied must be smoothed in this manner. Leather must be smoothed in the same manner also to remove all inequalities, and even the marks of the scraper.

The same method must be pursued with cloths or linens.

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[*] Tilloch, vol. 26, p. 1. From Bibliothèque Physico-Economique, May 1806.

Third Operation.—The down being removed in the manner above described, a coat of the black varnish, to be afterwards mentioned, must be laid on the articles to be varnished. They must be allowed to dry well upon their moulds, that they may not assume any wrinkles, which prevent the proper distribution of the varnish.

Fourth Operation.—This first coat of varnish being perfectly dry, the pumice stone must be again resorted to, in order to remove any small inequalities which may remain.

Fifth Operation.—When the air is dry and warm, a second coat of the black varnish must be applied, and also polished with the pumice stone.

Sixth Operation.—The finishing hand must now be put to the article by laying on the varnish to be afterwards described, taking care to employ for this purpose a small and compact pencil, in order to spread the varnish uniformly and equally.

When the first coat of varnish is well dried, it must be sprinkled with pumice stone reduced to fine powder, and then rubbed all over with a wet sponge, or a piece of fine linen rag also wetted, in order to render the varnish perfectly smooth; or in place of pumice stone, with tripoli soaked in oil and rubbed with the palm of the hand. As to the second and last coat of varnish, it must be polished when well dried, by sprinkling it with starch and rubbing it with a piece of old linen rag, which will give it a very fine lustre.

In the event of the varnish being tarnished, or losing its lustre by long usage, in order to restore it, place the articles of felt or leather in boiling water for a minute, then let them dry thoroughly, sprinkle them with starch, and rub them with a piece of dry linen, and they will resume their former lustre.

Preparation of Linseed Oil, under the Denomination of Oil of Marmite.

Take Linseed oil	.	15 pounds.
Umber	.	4 ounces.
Red lead	.	1 pound 8 ounces.
White lead	.	2 pounds 4 ounces.

Put the whole in a pot placed upon a coal fire; boil it for thirty-six or forty minutes; stir it from time to time with a wooden spatula; and care must be taken that it is neither too little boiled, nor viscous from being too much.

Upon taking the pot off the fire, throw in a piece of bread, both crust and crumb, of the size of a small loaf. Cover it, and let it cool for twenty-four hours. The oil thus prepared is made use of for various purposes.

Composition of the Black Varnish.

1. Take of black umber two pounds thirteen ounces; cut it into small pieces, and place them in a frying pan upon a very brisk fire, and roast it like coffee for about three quarters of an hour; bruise it afterwards upon a marble slab, by mixing it in the manner of painters, with a little boiled linseed oil, and keep it in a stone pot.

2. Take three pounds of verdigrise; reduce it to an impalpable powder; mix it with the boiled linseed oil; then put it into the stone pot which contains the umber.

3. Take of lamp-black one pound, mix it also with boiled linseed oil, and after putting it also into the stone pot, blend the whole well together.

This is the mixture made use of to varnish articles of felt, cloth, or leather, observing that when leather is to be varnished it is essential to give it previously two or three, and sometimes even six coats of linseed oil; it must be well dried each time, in order to extract the grease from the leather, wax, or fish oil, in order that the varnish may incorporate with the leather more easily. This precaution must be made use of with soft boots, when placed upon moulds or boot-trees; and, without even taking them off, as many coats of varnish may be laid on as necessary.

Method of preparing the Varnish.

Take of Prussian blue	.	12 ounces.
Indigo	. . .	12

Bruise these two separately upon a marble slab; mix them up with a little oil, and put them in a pot by themselves.

Afterwards take of gum copal	.	8 ounces.
Prepared nut oil		5
Spirit of turpentine		14

Put the gum-copal, bruised in a matrass with a large neck, upon a strong fire, but not flaming, taking care to stir it often, and to keep it uncovered. We know that the gum is totally dissolved when the smoke has entirely abated in the matrass; pour into it, by little and little, prepared nut oil, stirring it in order to incorporate the whole completely. Afterwards, and in the same manner, the spirit of turpentine is poured in, and the mixture is then taken from the fire, filtered, and cooled; it is then made use of to grind with the Prussian blue and indigo in small quantities at a time, and the whole is well mixed together.

This mixture forms the fine varnish for the purposes indicated.

NO. 15.

Account of a Method of making Soap of Wool, with Observations respecting its use in various arts. By M. CHAPTAL.*

I HAVE already shown the manner of making, at all times, in every place, and at a small expense, a saponaceous liquor which may be conveniently used, instead of soap, for domestic purposes. (See the Report of Messrs. Pelletier, d'Arcet, and Le Lievre, on the art of making soap.†) I shall now present to the public a supplement

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* *Repertory*, vol. 7, p. 346. *From the Annales de Chimie.*

† As that part of the report referred to by M. Chaptal appears to be of general utility, we shall here give a translation of it.

A very good way of using soap is, to employ it in a liquid state; that is, dissolved in water. In consequence of which, M. Chaptal proposes that saponaceous liquors should be prepared, which may be used instead of solutions of soap; and, in order to be able to procure such liquors, at all times, in all places, and at a small expense, he advises one or the other of the following methods to be practised. We shall describe them exactly as M. Chaptal communicated them to us, with observations thereon, made by himself.

First Method.

Take the ashes produced from the combustion of wood which has not been floated, and make a ley of them, according to the usual manner; mixing with the ashes a handful or two of quick-lime, well pounded, or recently slaked. Let the ley stand till it is grown clear, by the settling or swimming of the foreign substances contained therein: then pour it into another vessel, and keep it for use. When it is proposed to make use of this ley, take any quantity of oil, and pour upon it thirty or forty times as much of the ley. Immediately a liquor as white as milk will be formed, which, by being well shaken, or stirred, lathers and froths like a good solution of soap. This liquor is to be poured into a washing-tub, or other vessel, and to be diluted with a greater or less quantity of water; after which, the linen, meant to be washed, is to be steeped therein, to be rubbed, and wrung, in the usual way.

Observations.

1. It is better that the ley should not be made until the time when it is to be used: if it is left to stand in open vessels, its power is weakened, and its nature is changed.

2. Fresh wood ashes are preferable to old ones, particularly if the latter have been exposed to the air; in that case, they have no longer their usual power,

to my former work, instructing them how to prepare, as a substitute for soft soap, (which is at present made use

and we must, in order to make them serve our purpose, mix with them a greater proportion of quick-lime.

3. Those ashes also are preferable which are produced from hard wood: those which are left after the burning of floated wood cannot be made use of with equal success.

4. Fat oils, of a thick consistence, are most proper for the purpose here spoken of: fine thin oils are by no means fit for it.

5. If stinking oil be made use of, it is apt to give a bad smell to the linen; this may be removed by passing the linen carefully through a strong pure ley; but, in general, this smell goes off as the linen becomes dry.

6. When the mixture of oil with the ley is of a yellow colour, it must be diluted with water.

7. When the oil rises in the ley, and swims upon the surface of it, in the form of small drops, it shows that the oil is not fit for the purpose, not being thick enough; or else, that the ley is too strong, or not sufficiently caustic.

8. To prevent the quick-lime from losing its power, and that we may always have some to use when we want it, it may be broken into small pieces, and kept in bottles well dried, and well corked.

Second Method.

Floated wood, which is made use of in many parts of France, produces ashes which contain very little alkaline salt, and which are consequently very improper for making leys; in that case, barilla, or potash, may be used instead of them.

Take barilla, and break it into pieces about the size of a walnut; put these into a vessel of any kind, and pour upon them twenty times their weight of water: the water is to be left upon the barilla till it appears, by putting a little upon the tongue, to be slightly salt.

Some oil is then to be put into an earthen vessel, and forty times as much of the barilla ley is to be poured upon it: the mixture, which soon becomes milky, is to be well shaken, or stirred; and, after being diluted with more or less clean water, according to its strength, and the purpose for which it is intended, is to be made use of like a solution of soap in water.

Instead of barilla, potash may be employed, but it requires a small quantity of pounded quick-lime to be mixed with it.

Observations.

1. Alicant or Carthagena barilla may be used without any mixture of lime; but the bad barilla of our country requires to have mixed with it a greater or less proportion of lime, according to its degree of strength and purity.

2. When barilla, of whatever kind it be, is in a state of efflorescence, it cannot be employed without a mixture of lime.

of in fulling almost every kind of woollen stuff,) a kind of soap which costs little, and which may be easily made in every woollen manufactory.

In all manufactories of cloth, blankets, and other woollen goods, it is the custom to full the stuff, as soon as it comes from the loom. The intention of this operation is, not only to scour the cloth, &c. but also to render it more compact; and, in performing it, about thirty pounds of soft soap are used to eighty pounds of woollen stuff. In the south of France, before the revolution, soft soap cost twenty livres the hundred weight. A great part of our oil, and also of that of Italy, is consumed in making it; so also are the wood ashes of the fires used for domestic purposes, in those countries where it is made.

From what has been said, it is obvious how advantageous it would be to the manufacturer, and to commerce in general, to be able to supply conveniently the place of soft soap, by an article, the preparation of which is neither difficult nor expensive. Besides the saving which would take place in the manufacturing of woollen goods, great advantage would arise from the ashes of our wood fires being left, either for domestic uses, or for salt works, or for manufactories of green glass; and, at the same time, the oil now used in making soap would remain, to be wholly employed in purposes wherein it is impossible to find a substitute for it.

3. If the barilla ley is too strong, the oil is apt to swim on its surface; it must then be diluted with a proper quantity of water.

4. Fat oil is most fit for this purpose: fine light oils should not be used.

5. When the saponaceous liquor is greasy, and the linens washed in it are so likewise, they must be passed through a pure barilla-ley, to have their greasiness removed; which ley should first be warmed a little, to encrease its effect.

6. When the water which was poured upon the barilla is all used, fresh water may be poured upon the remaining barilla. This water will acquire a saline taste, like the first: thus, the same barilla may serve for several successive operations.

In all times, both the manufacturer and the government have sought how to get rid of the above mentioned inconveniences. Fullers earth, pure alkalies, and other things, have by turns been made use of. The first performs the operations of bleaching and fulling very imperfectly: the second dissolve the cloth; and the manufacturers of Lodeve still recollect, with terror, a quack sent there by the government, some years ago, who proposed to make use of mineral alkali or barilla, instead of soap.

To the inconveniences already mentioned we may add, that instead of rendering the cloth sufficiently soft and pliable, the substitutes just spoken of leave it in a degree of harshness, which nothing but soap completely removes. It is necessary, therefore, that any substance proposed to be used, instead of soft soap, should possess the power of scouring, of fulling, and of softening, the cloth. The composition which I am now about to describe unites all these advantages: experiments have, by my desire, been made with it, at Lodeve, by M. Michael Fabriguette; a person as well versed in philosophical pursuits as in manufacturing of cloth.

The whole process consists in making a caustic alkaline ley or lixivium, with wood ashes or potash; in causing the ley to boil; and then dissolving therein as great a quantity of old woollen rags, or shreds of cloth, as the ley will dissolve. By this means a kind of soft soap is produced, of a greyish-green colour, the ingredients of which are well combined with each other, and which is very soluble in water. It has an animal smell; which, however, the cloths get rid of, by being washed, and exposed to the air.

The various experiments I have made on this subject have been attended with the following results.

1. As soon as the wool is thrown into the boiling ley, its fibres adhere to each other, and a very slight de-

gree of agitation is sufficient to render its solution complete.

2. In proportion as fresh wool is added, the ley gradually acquires colour and consistence.

3. The soap has more or less colour, in proportion to the cleanness and whiteness of the wool made use of.

4. Hair of a coarser kind, which happens to be mixed with the old wool, is dissolved with more difficulty.

5. The quantity of wool which the ley is capable of dissolving depends upon its strength, its causticity, and its degree of heat. Two pounds, three ounces and three quarters, of caustic alkaline ley, at twelve degrees of concentration, and at the boiling heat, dissolved ten ounces and a half of wool. The soap, when cold, weighed one pound four ounces.

A similar quantity of alkaline ley, of the same degree of causticity and heat, in which I dissolved four ounces of wool, did not thereby acquire sufficient consistence to be capable of being used for the various purposes for which this soap is intended.

Another similar quantity of ley, of four degrees of concentration, could not dissolve more than two ounces and seven drams of wool. The soap was of a good consistence, and, when cold, weighed fourteen ounces.

6. In proportion as the wool is dissolved in the ley, the solvent power of the alkali grows weak, and at last it will dissolve no more. When we observe that the wool, upon being stirred in the liquor, is no longer dissolved, it is then time to stop the process.

I shall now point out what means are to be employed, in every woollen manufactory, to prepare the soap which will be wanted in it.

On the Choice and Preparation of the Materials.

The materials requisite to form this soap are only two; alkaline substances, and wool.

The alkaline substances may be procured from the ashes of any fires where wood is burnt; and the ley is to be made according to the common well known process. Quicklime is to be slaked with a small quantity of water, and the paste formed thereby is to be mixed with the ashes, (they being first passed through a sieve,) in the proportion of one tenth part of quicklime, by weight, to the quantity of ashes made use of. The mixture should be put into a stone vessel; (as wooden vessels not only colour the ley, but are themselves much injured by it;) and water is then to be poured upon it, in such quantity as to cover it, and rise some inches above it. These are to be left together for a certain time, and then the ley is to be drawn off, by an aperture, made for that purpose, at the bottom of the vessel. It is best not to draw off the ley, till the moment when it is to be used: its strength should be from four to fifteen degrees; but the degree of concentration is a matter of very little consequence, since all the difference that results from making use of a weak ley or a strong one, is, that a greater or less quantity of wool will be dissolved.

The potash of commerce may also be made use of; it is to be employed in the same manner as the wood ashes, but with one third of its weight of quicklime.

With respect to the choice of the wool, every one knows, that in the making of woollen cloths, blankets, and all other kinds of woollen goods, a series of operations are performed, from the first washing of the wool to the finishing of the cloth, &c. in each of which there occurs a loss, more or less considerable, of a portion of the original material. The water in which the wool is washed, the floor on which it is spread, and the warehouse in which it is deposited, exhibit sufficient proofs of this; so also do the operations of beating, carding, spinning, and weaving the wool, and those of shearing, combing, and fulling the cloth. It is indeed true that the scattered wool, produced from these various processes, is collected with some care; but many of them are of such a nature, that the waste wool resulting from them, either is dirty, and mixed with other substances, or it is cut so short, that it is rendered incapable of being again used: in either case, the manufacturer throws it on the dunghill. The making of the soap here described furnishes him with the means of bringing all these into use; nothing more being requisite than to collect them in the baskets in which the wool is washed, and to wash them carefully; as well for the sake of cleaning them, as to separate from them all foreign substances. When washed, they may be laid by till wanted.

We may also, with equal advantage, make use of the cuttings and shreds of woollen cloth, which are found in the shops of woollen drapers, tailors, &c. and likewise of all sorts of garments, or other woollen articles, after they have been worn till they will serve no longer.

On the Preparation of the Soap.

When the ley is made, and the wool procured, nothing remains to be done, but to bring the ley to a boiling heat in a common caldron. When it is brought to that degree of heat, the wool is to be thrown in, a little at a time, and the mixture is to be stirred, that the solution may go on the faster. A fresh quantity of wool should not be added, until the preceding quantity is dissolved; and the process should be stopped, as soon as we find that the liquor will not dissolve any more wool.

It has been ascertained, by trials in the large way, made by Michael Fabriguette, with soap of this kind, which he prepared according to my instructions, that such soap scours the cloths, felts them, and softens them, perfectly well; but there are some observations to be made, respecting its use, which are too important to be omitted.

First, when this soap is not prepared with sufficient care, or when it is made with dirty or coloured wool, it is apt to give the cloths, &c. a greyish tinge, which it is very difficult to remove. If the cloth is intended to be dyed, this tinge is of no consequence; but it would injure that fine white colour, which, in certain cases, is intended to be given, or to be preserved. This tinge, however, may be prevented, by a very careful selection of the materials for making the soap which is meant to be employed for such delicate purposes.

Cloths, &c. fulled with this soap, acquire, as was said before, an animal smell, which, without being very strong, is nevertheless unpleasant; but, water and air never fail to remove it.

Having succeeded in fulling woollen cloths by the use of this soap, I attempted to use soda, in the place of pot-ash, and thus to form (according to the process above described) a hard soap, fit for the operations of dyeing cottons; and my experiments succeeded beyond my expectations.

Forty-six pounds of soda ley (of eight degrees) dissolved, in a boiling heat, five pounds of wool; and afforded, when cold, sixteen pounds fourteen ounces of soap, sufficiently hard to keep its form.

The first quantities of wool thrown into the soda ley are easily dissolved; but it may be observed, that the liquor gradually grows thicker, and that the dissolution becomes more difficult and slower.

The ley, by the wool first dissolved in it, acquires a green colour; it afterwards grows black; and the soap, when cold, still retains a blackish green colour.

This soap has been made use of, in every different manner, and under every form, in my manufactory for dyeing cottons; and I am now satisfied that it may be employed, instead of the saponaceous liquor we are accustomed to make from ley of soda and oil, for the purpose of preparing the cottons. I have constantly observed, that if such a quantity of this soap be dissolved in cold water as will render the water milky, and the cotton be worked therein, in the usual well known manner, it will, by being passed three times through the liquor, and dried each time, be as strongly disposed to receive the dye, as cotton which has been seven times passed through the saponaceous liquors commonly used. This will not be thought very astonishing, when it is considered, that animal substances are very fit for disposing thread and cotton to receive the colours with which they are to be dyed; and that the intention of several of the operations to be performed upon them, previous to their being dyed, is merely to impregnate them with such substances.

It is necessary to remark, that cotton, by being passed through a solution of this soap, acquires a grey tinge, very much like that which is given to it by aluming; although the common saponaceous liquors give it a beautiful white colour. This grey colour, however, is no disadvantage to cotton which is intended to be dyed, as we have already remarked with respect to woollen cloths.

In confirmation of what I have said above, respecting the advantage to be derived from making use of this soap, I may add, that after having impregnated some cotton with it, according to the usual method, I made it pass through all the processes which wool undergoes, in order to be dyed of a scarlet colour. The consequence was, that the cotton was thereby dyed of a deep and very agreeable flesh colour; whereas, cotton which had not been prepared in that manner, came out of the bath almost of its natural colour. This first trial promises advantages which I mean to pursue.

It may be right to observe, that this soap of wool may advantageously be made use of, instead of common soap, for domestic purposes. I have employed it, with the greatest success, in washing linen; and it is particularly efficacious in scouring woollen garments, &c. I have no doubt that the facility and economy with which its preparation is attended, will cause its use to be extended to many other purposes; in the mean time, I thought it right to give an account of the various ways in which I have applied it.

I shall only add, that as the soap here described gives to woollens and cottons a grey tinge, which is very difficult to remove, it follows that it cannot be used for washing linen, unless it be made of white wool, carefully selected, and well washed.

No. 16.

Specification of the Patent granted to Mr. GEORGE CUMMINGS, *of Ludgate street, London, Toyman; for his Invention of a Composition to put on all Sorts of Skins, Paper, or Linen, for drawing or writing on with Pen and Ink, or Pencil, and rubbing clean off again.*[*]

Dated March 31, 1764.—Term expired.

TO all to whom these presents shall come, &c. Now know ye that, in compliance with the said proviso, I the said George Cummings do hereby declare, that my said invention of a composition to put on all sorts of skins, paper, or linen, for the use of drawing or writing on with pen and ink, or pencil, and rubbing clean off again, and to form it into a memorandum book, distinguished by putting the name of each day of the week on the top of each leaf of the book, and for other uses and purposes, is to be performed in manner following; that is to say, take either vellum, parchment, very fine cloth, or paper, and stretch it in a frame as tight as possible. Then take twelve pounds of white lead, and pound it very fine; add thereto one third part of the best plaister of Paris, and one-fourth part of the best stone lime; pound them well, mix them well together, and grind them very fine with water. Then take a new glazed vessel, and dissolve six or seven pounds of the best double size, over a fire, and mix the above ingredients in this, till it is of such a consistence as to lay on with a brush. Then lay three or four layers on the skin or cloth, as smooth as possible; observing that the skin is dry each time, before a second layer is put on. Then take the best nut or linseed oil, and to every pound of this oil add four ounces of the best white varnish, and mix them well together. Then put on three or four layers of this oil, thus prepared, each time exposing it to the air till it is thoroughly dry: this is for the white sort. For a brown or yellow, add to every pound of the above, three or four ounces of the best stone oker, or orpiment, or Dutch pink, and three or four ounces of litharge. These must be well ground with very old linseed oil, and laid on, as smooth as possible, ten or twelve times; exposing it each time to the air, to be thoroughly dry, before a second layer is put on: observe you do not put it where any dust or dirt can fall upon it. It may be, by the same process, altered to any colour: as for instance; to a red, by tincturing it with vermilion, or the like; to a blue, Prussian blue; and for a black, by pounding slate, grinding it very fine, and mixing with it as much ivory-black as will turn it to a fine black colour. When it is thoroughly dry, you may write on it with a slate pencil, or black or red lead. In witness whereof, &c.

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[*] Repertory, vol. 7, p. 231.—This is what was called *German asses-skin.*

No. 17.

*List of English Patents.**

(Continued from vol. 1, page 480.)

1797.

John Manton, April 12, invention or improvement in the construction of guns and pistols.

Rob. Cross, April 26, a new invented tan-pit, and mode of tanning.

T. Todd, May 9, an hydraulic pump or machine for raising water.

Richard Varley, May 29, a perpetual moving-power.

Timothy Harris, July 4, method of manufacturing pins, with iron and other metals, and making the same white.

Joseph Slater, July 4, improvement in a machine for finishing bleached, dyed, and printed muslins.

Anthony George Eckhardt, July 4, method of making draw or bench looms, for manufacturing carpets, borders, and other things.

John Hawksley, July 4, method of combing wool, cotton, silk, flax, hemp, and mohair.

John Maule, July 4, improvement on a machine for cleaning grain from the straw.

John Richardson, July 4, machine to be applied to glasses and pebbles of every description, for the use of sights in general.

Henry Johnson, July 7, a water-proof compound, and a vegetable liquid for bleaching, whitening, and cleansing woollens, linens, cottons, &c. and also for preparing stuffs or cloths made of wool, linen, cotton, or silk, in order, by the application of the aforesaid water-proof compound, to render them impenetrable to wet.

Archibald, earl of Dundonald, Aug. 16, method of preparing ceruse, or white lead, which he conceives will be of great public utility, particularly as he has reason to believe it will not be injurious to the health of persons employed therein.

Anthony George Eckhardt, Aug. 18, method of constructing pumps and engines for evacuating water or other fluids, extinguishing fires, &c.

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* Repertory, vol. viii.

William Chapman, Sept. 13, method of laying, twisting, or making ropes or cordage, of any number of yarns or strands, or any number of threads, tarred or untarred.

Samuel Stanfield, Sept. 13, machine for roving or spinning of cotton, flax, hemp, worsted, yarn, wool, &c. and for doubling and twisting silk, cotton, and thread.

Charles Baker, Oct. 11, method of preventing the smut in wheat.

Edmund Cartwright, Oct. 11, an incombustible substitute for certain materials commonly used in constructing dwelling-houses and other buildings.

Harry Watts, Oct. 19, implement for draining land.

Joseph Bramah, Oct. 31, method of retaining, clarifying, preserving, and drawing off all kinds of liquors; with sundry improved casks, and implements, necessary to give his contrivance the full effect.

John Harriott, Oct. 31, new invented cog-wheel crab, or capstan, with geers, to work ships' pumps, engines, and hydraulic machines, to give a ship way through the water, in calms or light winds.

Thomas Paton, Oct. 31, new invented press.

John Parrish, Oct. 31, method of rendering all kinds of woollen cloth impenetrable to moisture or wet, or water-proof, without affecting their beauty, colour, or wear.

Robert Beatson, Oct. 31, method of applying the power of wind or water to horizontal mills, the principle of which may be also applied to several other purposes.

Henry Overend, Nov. 9, machine which may be used as a waggon, cart, or dray, in a more perfect and expeditious manner, and with fewer horses, than usually and heretofore done.

Edmund Cartwright, Nov. 11, improvements in the construction, working, and application of steam engines.

Daniel Langton, Nov. 18, locks, springs, and machinery, for the security of doors, and for preventing rain or wet from passing under them, and which will cause doors to pass over carpets, &c. and will prevent cold air from passing under or over the same, and, by that means, keep rooms warm.

John Crooks, Dec. 12, method of making soap, and bleaching, by means and use of mineral and vegetable alkalies.

James Weldon, Dec. 22, machine or mill for breaking, grinding, and pulverising, patched or chopped bark, for tanning; and for breaking, grinding, and pulverising, different kinds of wood, and other hard substances.

William Milton, Dec. 23, method of causing ships, vessels, barges, boats, and craft of all sizes, to be built at prices considerably below what are given for them, as built in the present mode; and for rendering the rudders thereof, in some cases, more effectual.

Matthew Boulton, Dec. 30, apparatus and method of raising water and other fluids.

1798.

Anthony George Eckhardt, Jan. 16, method of making chairs, stools, benches, &c. adapted for rooms or carriages, with backs or seats and cushions fixed in such a manner as instantly to change, and show two different surfaces in one seat or cushion.

Samuel Roberts, Jan. 23, working, adjusting, supporting, and fixing, slide-tube candlesticks of silver, silver plated, or other metal.

Charles Tennant, Jan. 23, method of using calcareous earth, and the earths strontites and barytes, instead of alkaline substances, for neutralizing the muriatic acid gas used in bleaching; and for employing those earths in the other parts of the process of bleaching, instead of alkaline substances.

Archibald, earl of Dundonald, Jan. 25, method of manufacturing and procuring certain neutral salts, substances, and things, and of applying those and other neutral salts to valuable purposes.

Richard Shannon, Feb. 1, method of improving the processes of brewing, distilling, boiling, evaporating, and of raising, and condensing, steam or vapour, from aqueous, spirituous, saccharine, and saline fluids.

Henry Clay, Feb. 1, method of saving part of the water now lost, in passing boats and barges through locks on navigable canals.

Robert Howden, Feb. 10, portable and moving furnace, for the purpose of heating ovens of every description.

Francis Farquharson, Feb. 20, machinery for making bricks and tiles.

James Douglas, Feb. 20, machine for making bricks.

Walter Taylor, Feb. 21, improvement in the construction of machines for raising water, and clearing ships of the same; also to take off the pressure of the atmosphere, or eddy winds, from the tops of chimnies, to prevent what are commonly called smoky chimnies.

(To be continued.)

Hydraulic Ram.

The hydraulic ram of M. Mongolfier has been constructed at Schaffhausen by counsellor Fischer in a very ingenious manner. The machine has the form of a beautiful antique altar, nearly in the style of that of Esculapius, as represented in different engravings. A bason about six inches in depth and from eighteen to twenty in diameter receives the water, which enters into pipes three inches in diameter, that descend in a spiral form into the base of the altar. The water by its weight puts in motion a valve; a third nearly of the water escapes, but the rest by the pressure of the valve is forced into the receiver, and thence rises in very narrow pipes. As it ascends slowly the resistance of the air makes no sensible impression, so that by means of this machine, which continually acts by itself, water may be conveyed from a lake or a river to houses situated on a mountain. M. Fischer has conveyed water by it to a castle which stands at the height of several hundred feet above the level of the Rhine. *Tilloch*, vol. 20.

Water-proof Cloth.

It is well known that for some years past several methods have been tried to render cloth impermeable to water, and the inventors of this process have kept the discovery a mystery. There was, however, reason to suppose that some fat oil made the basis of their recipes. A bottle of this liquor, the efficacy of which was known, having fallen by chance into the hands of M. Vauquelin, he was desirous to discover the composition of it. The following is the manner in which this chemist thinks it is composed, bating the proportions. Soap and strong glue, or any other gelatin, are dissolved in water. With this solution is mixed a solution of alum, which, being decomposed, forms in it a flaky precipitate, composed of oil, alumine, and animal matter. Weak sulphuric acid is then added, to redissolve a part of the alumine, and to render the precipitate lighter, and to prevent it from falling to the bottom. But the alumine, when once combined with the oil and animal matter, does not redissolve entirely in the sulphuric acid; for this reason the oil always remains very opake, and neither rises nor is precipitated. It may readily be conceived, that too large a quantity of sulphuric acid must not be added. M. Vauquelin does not know whether this be exactly the process, but by following it he has been able to obtain a similar liquid, which possesses the same properties. *Ibid.*

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

[illegible] fc.

David Rittenhouse.

Born April 8th 1732. Died June 26th 1796.

THE

EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 2.] DECEMBER, 1812. [No. 8.

NO. 18.

Memoir upon the Vineyards and Wines of Champagne in France: Written in answer to certain Queries circulated by M. CHAPTAL. *By M.* GERMON, *of Epernay.*

(Continued from page 12.)

XXIII. *What is the Method of operating in the Press, in order to make White Wine?*

THE press being previously well washed and cleaned, and the screw inspected and greased, the fruit is pressed by three successive and rapid turns of the screw in certain districts, and by two only in others, according to the experience of the proprietor, the strength of his machinery, and the expertness of his workmen, or the nature of his grapes. The whole of this operation should be finished in less than an hour by good workmen. Before applying the press, three or four layers of billets or pieces of wood are thrown upon the grapes, placed in such a way as to make the pressure general. After allowing the juice to flow for about five minutes, the press is slack-

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ened, in order to stir up the remaining mass, and clear away any obstructions, and the operation is repeated.

The wine flows through a hole into a small tub, called a *carbou*, placed under the press.

When the three pressures have been effected, the wine produced from the juice is called *vin d'elite*, or choice wine. It is called in the language of the workmen *vin de cuevée*, or wine of the tub; but of this expression I highly disapprove, as it gives an idea to strangers that the white wine of Champagne is allowed to ferment (*cuver*) in tubs.

This *vin d'elite* is carried from the *carbou* into a tub adjoining, in which it is allowed to deposit its lees and all other heterogeneous matters during the night: this tub is called the *cuve de depot*.

After this *vin d'elite* is extracted, there still remains some juice in the husks of the grapes: a new turn therefore is given to the screw of the press, and the wine issues through a hole placed a little lower in the press into another tub: this juice is called the *first cut*, (*premiere taille*,) and frequently enters into the composition of the *vin d'elite*. If the wine is not already too vinous, the juice from this last pressure is allowed to flow for about an hour, according to the season or other circumstances.

Another pressure is still given at a subsequent period, and the wine is called *deuxieme taille*, or *vin de tisanne*, so much called for at certain seasons.

A third pressure is sometimes given at another interval, and the wine is muddy, hard, and vinous.

Lastly, a poorer kind of wine, called *vin de rebechage*, is produced by repeatedly pressing the husks until they are perfectly dry: these operations are also called drying the huks.

The *vin d'elite*, after having been allowed to remain all night in the tub, where it deposits its sediment, &c. is put into new or well rinsed puncheons, and the juice from the subsequent pressures is successively treated in the same way.

XXIV. *What Use is made of the Wines last drawn off, which are generally very spirituous; but which, being coloured, cannot be mixed with the first Juices?*

As it has been experienced that the Champagne wines of the last pressures, notwithstanding their vinosity, are too weak, and would occasion too much waste of time and expense to distil them into brandy, it is found more advantageous to sell them in the vineyards of inferior quality, in order to improve the poorer kinds of wine: they are sometimes sold also to innkeepers, after a sufficient quantity has been retained for the use of the domestics of the proprietor.

In some places, however, these wines are distilled; but it requires from five to eight pieces of them to make one piece of brandy.

[Articles 25, 26, 27, and 28, regard the making of red wine, and will be treated of under a separate head.]

XXIX. *How is Red Wine made?*

The grapes for making red wine are managed with the same precautions as those for white wine.

The only difference consists in loosely depositing the grapes for making red wine in vessels for the purpose: these vessels are covered, and their contents are allowed to remain until the first fermentation has begun in the colouring pellicle of the fruit.

This must, in a state of fermentation, is deposited under the press: the same turns of the screw are given as to the white grapes.

XXX. *How are the White Wines managed until they are fit for drinking?*

The white wine, when left in the state described at the end of No. XXII. enters into fermentation, at first rapidly, and afterwards in a milder manner: when it has gone through all these degrees of fermentation it becomes clear; and when the weather is dry with a clear frost it is racked off, being previously fined with a proper quantity of isinglass. With one pound of Marseilles isinglass forty pieces of wine are fined.

XXXI. *What is the Process of clarifying White Wines; and at what Age are they bottled?*

The isinglass is prepared by breaking it, in order to divide it into small pieces: it is then diluted in some wine drawn from the puncheon. When both are well mixed up together, it is introduced into the bung-hole of the cask, its contents being briskly agitated with a staff or other instrument: the wine is then allowed to rest: it undergoes another slight fermentation, until the coldness of the weather finally settles it.

One month or six weeks afterwards it is again racked off; and a slight proportion of isinglass is added, to bring it to a state of perfect limpidity.

XXXII. *At what period is it bottled?*

In the month of March these wines are generally bottled.

XXXIII. *How is the Operation of Bottling performed?*

The wine is drawn off into bottles well chosen, well rinsed, and of an approved manufacture: they are corked with the very best kind of corks: pieces of thread or iron wire are used for fixing down the corks firmly; the bottles are then put into the cellar, and piled up on their sides.

The elaboration of the juice not being completed when the wine is bottled, a slight fermentation takes place in the bottles. About the middle of August in the same year this fermentation begins, and frequently there is a loss by the end of September of five or ten per cent, from the bottles breaking. This loss sometimes goes on increasing until next year, according as the wines are more or less juicy or vinous.

XXXIV. *Is it necessary to cover the Corks with Wax.*

It is not necessary to wax the corks when the wine is bottled: this expense would be thrown away; since about fifteen or eighteen months after being bottled, when the wine has exhausted all its fermenting principles, and is to be sold and sent off, it must be again disturbed, in order to undergo the operations pointed out in No. 38. This moving of the wine consists of making a slight deposit disappear, which, notwithstanding the first clarification, is indispensable in the different operations necessary: Secondly, such bottles must be filled up as have leaked or lost by filtration through the corks, and the broken bottles are also to be removed.

XXXV. *What are the Faults to which White Wines are subject, either in Casks or Bottles?*

The faults to which white wines are most liable are muddiness, (*la graisse,*) acidity, and sometimes also yellowness of colour. White wine very rarely becomes muddy when in the casks; but this happens sometimes with bottled wines.

The wine is said to be greasy (*gras*) when it is milky and whitish, and when it does not sparkle and present bubbles on its surface when hastily poured out.

When it is ascertained that this accident has happened, care must be taken not to disturb the wine, and the disease generally cures itself by the next or following spring. The whitish sediment turns brown, and deposits or attaches itself to the bottle; and the wine becomes once more diaphanous and sparkling.

XXXVI. *What are the Means used to remedy this?*

When the season has been rainy, the vintage wet, and the juice is too watery, this disease is very frequent; and besides, if the white is in more abundance than the red fruit, the yellow disease is mixed with what is called the greasy, and in this case it is no longer fit for sale: it has a disagreeable taste, and is of the colour of cider: nothing can be done with it, unless it is mixed with common or inferior red wines.

Greasy wines must be cured by time alone; and they very rarely continue more than a year in this state.

All the preservatives recommended in books upon this subject are of no avail: when employed, they are found to injure the quality of the wine instead of improving it.

Note. Acidity being more peculiar to red wines, it will be treated of under that head.

XXXVII. *How does it happen that Half of the Bottles are broken during the first Six Months?*

The breaking of the bottles is owing to several causes more or less direct and more or less well ascertained.

It depends in the first place upon the choice and quality of the wine; the time at which it is put into bottles; the quality of the glass; the nature of the cellar; the temperature of the weather, and even on the way in which the bottles are packed. We cannot therefore assign the exact cause of this accident, so much connected with the phenomena of nature: in general, however, when a proprietor has no more than twenty bottles broken in one hundred he does not complain.

XXXVIII. *When White Wines deposit a Sediment in Bottles, what are the Methods of extracting this Sediment before sending them off to their Place of Destination?*

The sediment in white wines, when they are not spoiled in other respects, is made to disappear in the following way:

If the wine is not muddy the operation is very simple: it consists in emptying the bottle with care, keeping it in the precise direction in which it lay: the workman with a small hook removes the iron wire which fixes the cork; he then uncorks the bottle, and presents in a perpendicular direction another bottle to it quite empty and well rinsed, and pours out all the wine, leaving the sediment, which, if the bottle has not been shaken, will remain at the bottom.

Some persons make use of a siphon, when the wine is not thick, in order to avoid all shaking.

When the wine is thick the operation is more tedious and more delicate: wooden planks are made use of, in which holes are made at proper distances, in order to receive the bottles: these planks being arranged, adjoining to the collection of bottles, an intelligent and experienced workman carefully takes a bottle from the heap, keeping it in the same position in which it lay: he then gives it a slight shake, and by a regular and long continued movement he brings into the side of the bottle the sediment which is detached, and, without scattering it through the liquor, makes it slowly descend to the neck: he then places his bottle upon the plank which lies ready to his hand, inclining it in a sloping direction: he afterwards does the same by a second, a third bottle, &c. which he places in the same sloping direction.

Four-and-twenty hours afterwards the workman returns to the plank where he has deposited his bottles; he once more gives them a slight shake, and slopes them a little more, in order to bring the sediment nearer to the cork: if the sediment has then completely fallen down, and the wine is limpid, the workman holds the bottle perpendicularly elevated, and does the same with all the rest of the bottles placed upon the planks: he returns with his hook, uncorks the bottles, and with a dextrous motion of the wrist turns them upside down: the fixed air escapes and pushes out the sediment, which falls into a receiver: the workman then dextrously replaces the bottle upon its end, after allowing nothing to escape, except what is necessary to render it limpid. Another workman then fills it up with good wine, recorks it, and the wine is fit for sale.

By this delicate and cautious operation, the wine loses nothing of its briskness, but occasions a great expense in utensils, fresh corks, wire, labour, &c. It has become necessary, however, of late, since the consumption of Champagne has become so general throughout Europe, and great exertions are made to keep up its celebrity.

XXXIX. *Do the sparkling Wines keep well?*

The wines of Champagne, after being put into circulation, and having travelled about, preserve their good qualities for ten years: but when they are kept in cellars, and particularly in those of Champagne, which are superior from the nature of the soil, (being dug out of beds of chalk,) they will keep for twenty and thirty years.

XL. *What Degree of Temperature is best adapted for the Preservation of Wines?—Point it out with reference to Reaumur's Thermometer.*

I am well convinced that it is by always preserving an equal temperature that the breaking of the bottles may be avoided when in the cellar. Currents of air passing through the cellars should by all means be prevented: but in order to establish an equal current of air, the cellars should be dug very deep: they, however, would be so expensive that few proprietors could be prevailed on to adopt such a regulation. At Rheims, Ay, Hautvillers, Epernay, Cramant, and Vertus, there are, I have seen, some cellars made upon a most excellent plan, and where no expense has been spared.

I have never tried the temperature of the air of the cellars, and I cannot give any results upon this head.

[Articles 41, 42, 43, 44, and 45, being entirely applicable to the management of wines, will form part of a particular treatise upon the subject of red wines.]

XLVI. *What is the Price of an Acre of the best Vineyard Ground?* (The acre being 100 rods and 22 feet.)

At Ay	6000 livres.
Hautvillers	3000
Epernay, Pierry, Avise, Cramant	3000
Other vineyards	2000

XLVII. *What does an Acre of the Second Quality cost?*

At Ay	3000 livres.
Hautvillers	2500
Epernay, Pierry, Avise, Cramant	2000
And the other vineyards . .	1000.

XLVIII. ***What is the Expense of the annual Culture of an Acre of Vineyard, including the Expense of Prunings and of Vintage?***

	Livres.
The ordinary expense of cutting, hoeing, tying, and pruning the vines	80
Expense of occasionally propping up such vines as have fallen, &c.	60
Sixteen or eighteen bundles of props, fifty in each bundle	30
Dung and carriage of the vines, &c. . . .	42
Five empty puncheons for each acre's produce, at ten livres	50
Expense of gathering, pressing, keeping the labourers, &c. &c.	46
	308

Produce of an Acre of Vineyard.

It is generally understood, that, taking the average of ten vintages, five pieces or puncheons of wine are obtained from every acre.

Three of these are of the first quality, or choice wines: and two of them are ordinary wines.

	Livres.
The three puncheons of best wine may be valued at 150 livres each	450
The two others at fifty	100
First result . . .	550
From which we must deduct the expense of bottling and of cooperage at ten livres for each piece of the best wine. The fining of these wines being most expensive	30
For the two other pieces three livres only . .	6
Annual interest of the money laid out for the ground, &c.	100
Taxes, &c.	72
Labour, &c. as above	308
	516

	Livres.
First result	550
From which deduct as above	516
Net produce of an acre of vineyard in middling years	34

We may easily perceive that the net produce cannot be estimated upon very just and rigorous data, as the wines of Ay, Hautvillers, Epernay, and Pierry, fetch from two hundred to four hundred livres each piece; and a mean price must be fixed for all the other classes of Champagne wines, which sell for ninety up to two hundred livres.

It follows from this statement, that, without great industry, a proprietor can derive but a small profit, who is obliged to sell annually in the cask the produce of his vines: the rich proprietor only, who can afford to put his wines into bottles, and keep them for two or three years, can depend upon a certain and real profit.

In what Manner is the Vine planted in the Mountain?

The vines are planted differently in the mountain and on the banks of the river. The greater part of the vine-growers, who have contracted habits which they will not give up, notwithstanding the inconveniences which they are every day aware of, plant their vines in March only: the shoots they use are either produced from the tall vines, which have been beaten, and which have very few roots, or from other plants which spring up among the low vines at the moment of cutting the vines, and which have also very few roots, since they are procured from stalks that have lain on the ground since the commencement of the season.

(To be continued.)

No. 18.

Method of painting Linen Cloth in Oil Colours, to be more pliant, durable, and longer impervious to Water, than in the usual Mode. By Mr. WILLIAM ANDERSON, *of His Majesty's Dock-Yard, Portsmouth.**

SIR—I beg leave to lay before the Society of Arts, &c. the following improvements and observations, which I hope will be of service to the public.

Having never heard or read of any method being discovered to prevent paint when laid on canvass from hardening to such a degree as to crack and eventually to break the canvass, and render it unserviceable in a short time; and having been an eye witness for many years of much canvass perishing for want of such discovery, in the immense quantities painted for covering seamen's hammocks, and for other uses on board his majesty's ships; I long had it under consideration to find out such an ingredient as, when mixed with paint, would preserve the canvass and paint laid thereon from the damages above mentioned: and after experiments for a considerable time, I have discovered such an article, and made trial of it with effect above three years.

The canvass I have painted has been submitted to the inspection of the Navy Board, who are so perfectly satisfied with my new method, that general directions are now given to paint all canvass in his majesty's dock-yards in this manner; which, in addition to the advantages I have before mentioned, actually saves an expense of one guinea in every hundred square yards of canvass so painted, as I have fully stated to them. The ingredient I use is not only serviceable for ships' canvass, but also for canvass designed for paintings, for floor cloths, and for painted coverings within and without doors. I have no doubt of it being applied to many other purposes I am yet unacquainted with; as, from actual trials for near four years, I can vouch for its being a preservative to red, yellow, and black paints, when ground in oil and put in casks. When the paints were examined at the expiration of such time, they discovered no improper hardness; but when laid on the work with a brush, they dried in a remarkable manner, without the addition of any of the usual drying articles. I still preserve some of these paints for future trials, and I believe this plan of preserving colours will be of essential use to colourmen, and other persons who purchase colours for exportation. The ingredient I use is perfectly simple, being a solution of yellow soap; and the composition for painting is made in the following manner:

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* Tilloch, vol. 33, p. 151. From *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce,* for 1807.—The silver medal of the Society was voted to Mr. Anderson for this communication.

To one pound of soap I add six pints of water in a vessel over the fire; in a few minutes after the boiling of the water the soap will dissolve; whilst hot it is to be mixed with oil paint, prepared as hereafter directed, and is then fit for immediate use. The above quantity of soap solution will be sufficient to mix with one hundred weight of paint. The first coat to be laid upon the canvass is to be entirely of this composition, without first wetting the canvass in the usual way. A very small proportion of it, or none, is necessary in the second coat; and the third coat should be of oil paint alone.

The method heretofore practised in his majesty's dock-yards for painting canvass, was as follows: The canvass was first wet with water, then primed with Spanish brown; a second coat given it of a chocolate colour, made from Spanish brown and black paint; and, lastly, finished with black. This mode is destructive, and more expensive than mine in the proportion before mentioned. In my method, to ninety-six pounds of English ochre ground in boiled oil, I add sixteen pounds of black paint, being one-sixth in proportion of the ochre; this, when mixed, forms an indifferent black. The solution, made of one pound of soap and six pints of water, is to be added to this paint, and well united therewith; and without the canvass being previously wet, this composition is to be laid upon the canvass as stiff as can conveniently be done with the brush, and this first coat will form a tolerably smooth surface. The second coat is to be formed of the same proportion of English ochre and black, without any soap solution; and the third or finishing coat, to be done with black paint as usual. I am, &c.

WILLIAM ANDERSON,
Master Painter of H. M. Dock-Yard at Portsmouth.

Portsea, October 31, 1806.

SIR—Agreeably to the request in your letter, I have enclosed certificates relative to my new method of painting canvass; and I take the liberty of informing you of a method of obtaining from painted canvass, unserviceable, the whole of the colour laid thereon, and to do it at a very small expense. This I discovered since I last wrote to you, and I believe it will be of considerable advantage to government, who, for want of such a thought, have buried and burnt immense quantities of ships' hammock cloths, when found unserviceable, to prevent embezzlement from taking place. I suggested the idea to N. Diddems, esq. builder of Portsmouth yard, who communicated it to the honourable George Grey, commissioner. I obtained leave to make an experiment, which I repeated thrice, and found that from one ton of painted canvass, unserviceable, I obtained, upon an average, four hundred weight of dry colour, in value to government nine pounds six shillings; the expense of the process not exceeding six shillings.

This I effected by calcination, raking aside the ashes and sprinkling them with water, to prevent loss of paint through excess of heat. By passing the calcined matter through a fine sieve, it is perfectly prepared for grinding; it grinds well, possesses a good body for covering with, and dries well with a good gloss. Its increase of bulk, in comparison with common colour of equal weight, gives it the advantage of covering more work. The colours yielded by the calcination of different coloured canvass are as follow: viz. Canvass which has been painted with black paint only, produces a black colour. Canvass finished black, but which has had a previous red or yellow ground, will produce a dark chocolate colour. Canvass painted lead colour will yield a good dark lead colour. I am, &c.

William Anderson.

Portsea, March 25, 1807.

To C. Taylor, M. D. Sec.

Certificates, dated March, 1807, were received from the following persons, viz.

A. Stow, lieutenant and commander of the gun-brig Steady, stating, that in the preceding month of October he had received on board his ship a set of hammock cloths, painted after the method invented by Mr. William Anderson, which had been constantly in use since the time above mentioned, and appeared fully to answer the end proposed, of rendering the canvass soft and pliable, of preventing its cracking, or the paint peeling off, and which in the old method had been a subject of much complaint.

John Pridy, lieutenant and commander of the Gladiator, and formerly commander of the Dapper, on which latter ship a set of hammock cloths, painted after Mr. Anderson's method, appeared fully to answer the end proposed.

P. F. Wyatt, oil and colourman, Portsea, stating that he had seen canvass painted after Mr. Anderson's new method, which, after a trial of sixteen months, remained perfectly soft and pliable, the paint by no means cracking or peeling off, and that the gloss was retained, though it had been exposed to all weathers. He further added, that he had seen the paint prepared by him from old painted canvass found unserviceable, and had worked and painted therewith; that it was, in his judgment, very good, and would answer either on canvass, wood, or iron.

Ns. Diddems, master shipwright, Portsmouth dockyard, stating, that Mr. Anderson had proposed to him to obtain, by calcination, from old unserviceable painted canvass, the paint which had been laid thereon; that such experiment was made, and four hundred weight of dry serviceable paint prepared from one ton of such canvass; that he had seen it when ground in oil and laid on work, when it appeared to possess all the properties of good paint, and had therefore been recommended by him to the Navy Board.

Sir—In answer to your letter of the 25th of April, in which you informed me that the committee were desirous that I should furnish them with a sample of canvass painted in the old method, and another on my improved plan, I trust that I shall be able fully to comply with their request. In the first place, I have sent a small sample of the residuum of the burnt canvass, fit for grinding in oil for paint, also a piece of canvass painted therewith, marked No. 1; another piece painted after the old method, marked No. 2; another piece painted according to my process, marked No. 3; and, lastly, a piece finished entirely with a new composition, marked No. 4; each sample having received three coats of paint. Upon examining No. 2, you will find it becoming from time to time more stubborn, in consequence of the paint hardening; and when a small ridge is formed in it, by pressing it between the finger and thumb, it will soon discover that it is subject to crack, and by this means, permitting the wet to enter it, will soon rot the canvass.

The space of time proper between laying on the new preparation and the second coat, ought to be one entire day; but if saving time is an object, the second coat may be put on the day following the first; for, if the canvass is placed in an advantageous situation for drying, the composition will dry or harden so as not to rub off.

Canvass finished entirely with the composition, leaving it to dry one day between each coat, will not stick together if laid in quantities, as you will find by making experiments on the sample No. 4.

Since the Navy Board have given directions for ship's canvass to be painted according to my method, I find, upon calculation, that I have painted upwards of twenty thousand yards since November last, a great part of which has not been hung up for painting and drying more than one week, as no more time could be allowed me, in consequence of ships sailing. My plan was therefore to lay on the composition the first day, to coat it the second day, and, leaving one intermediate day, to finish it on the fourth. Three days were then allowed it to dry and harden; and when afterwards taken down and folded together in cloths, containing sixty or seventy yards, they did not stick together.

Having no means of giving information to persons concerned in grinding colours, so well as through the medium of the Society of Arts, &c. I beg leave further to relate how I have, for the last three years, saved the labour of three men out of four in grinding colours with the common mills employed for that purpose. One mill has ever been considered sufficient for a man to turn, whereas one man can now, with perfect ease, turn four mills; this is effected by placing two mills on each side of the winch, so close as only to leave room for the fly wheel to play between them. The spindles of each on either side are locked together by a small iron collar, with a pin passing through it. The distance of the mills thus paired from each other, in order for the man's standing between them to turn, is two feet six inches. The distance of the arms of the winch screwed on the end of the spindles on either side, is two feet two inches; the length of the arm is one foot six inches from the spindles to the bar across which the man clasps in order to turn.

Fly wheels at the extremity are impediments. Necessity was truly the mother of invention to me in this case, as I had great demand for paint, and I was not allowed men sufficient for the work in the common way.

Persons will scarcely believe, without seeing the experiment, the ease with which they turn. If a little extraordinary motion is first given them, and they are then left alone, they will continue to go round sixteen times; so that a man with one hand may turn them. I am, &c.

WILLIAM ANDERSON.

Portsea, May 6, 1807.

To C. TAYLOR, M. D. Sec.

SIR—I have stated to the Admiralty Board the several improvements made by me in paint work; and in consequence thereof they have desired the principal officers of our yard to report to them on their merits. The officers, who have for more than twelve months past daily had the execution of them under their inspection, have recommended the same in stronger terms, and the advantages thereof, to the lords commissioners, beyond my statement. I have enclosed to you a certificate relative to the ship Hibernia, which arrived here the 12th of May last, and for which vessel I painted a set of hammock cloths, containing thirteen hundred yards of canvass, in June 1806, after my new method. I am, &c.

WILLIAM ANDERSON.

Portsmouth, Nov. 27, 1807.
To C. TAYLOR, M. D. Sec.

NO. 20.

Description of a Revolving Telegraph, for conveying Intelligence by Figures, Letters, Words, or Sentences.

By JOHN REDMAN COXE.

[With an engraving.)

In the construction of a telegraph, it must be obvious that certain principles are to be kept in view. These are,

1. That the signals should be few, plain, and readily perceptible.

2. That the machine itself should be of a nature to combine strength, durability, and easy execution.

3. That it should be susceptible of being worked with facility, exactness, and despatch.

With respect to most of the telegraphs of which we have any account, some will be found to possess some of these points, whilst they are deficient in others; and it is not too much, perhaps, to assert, that not one is altogether possessed of every qualification, which shall render this machine extensively useful.

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Without hoping that the one I am about to describe is free from every objection, I am disposed to regard it as more perfect than any one in present use; and I would flatter myself, that the principles on which it is constructed, may, by experience, be so much improved upon, as to prove it really the important instrument of communication the name implies.

A cursory view of the accompanying engraving, will give a general idea of its formation, so as to render the description easily to be understood.

This machine consists of a semicircle of any required magnitude, raised upon and firmly fixed to a strong wooden frame, four, six, or eight feet high, by means of iron rods or radii. To this frame is connected a strong upright shaft of wood or iron, passing through the lower horizontal beam, and having attached at this part a perforated shoulder, for the passage of the ropes from the machine to the observatory below. This shoulder is firmly fixed in the beam; but is continued downwards a sufficient distance to rotate in a circular opening of the roof of the building, the shaft itself reaching to the bottom of the chamber, and is there received in a socket in which it plays. The object of this contrivance is, to permit the rotation of the telegraph without any obstruction to the free play of the ropes. The rotation, though in part effected by the shaft, is more especially dependant upon two or more strong iron castors, or rollers, sunk into the lower beam on each side the centre, and running on horizontal circles of iron let into the roof. The shaft preserves the machine in its proper situation.

The frame is so constructed as to permit a strong iron cap to be fixed to the head of the shaft, which branches out into two arms, to form the centres, in which the axes of the wheels of the telegraph freely rotate. Of these axes, the one, interior and solid, passes through the other, which is a cylindrical tube. Of the two wheels which work the shutters of the windows of the telegraph, the *outer* one is fixed to the solid axis, which, at the further extremity, where it passes out from the hollow axis, has a short upright, to which is attached a returning arm, running parallel with the axis, and having at the extremity one of the shutters dovetailed into it; beneath this, a friction roller plays upon the periphery of the hollow axis, thereby supporting the weight of the shutter, and facilitating the motion. The *inner* wheel is connected to the edge of the hollow axis, and has the second shutter morticed firmly into its interior edge, so that it plays exterior to the first shutter, as closely as the parts will admit; and to prevent any interruption from each other, a narrow semicircular rim along the edge of the telegraph may be adapted, to preserve each in its line of motion.

These shutters are formed of thin well seasoned plank, sheathed with copper or tin plates, or the shoulders may be small iron rods, terminating in broad paddles of an appropriate form. The wheels which work them may be of any size that experience shall direct, probably about one third in diameter, of that of the semicircle constituting the telegraph.

The telegraph itself is formed of two parallel semicircular sheets of iron or copper, of six inches or a foot wide, situated about two, three, or four feet apart, (more or less, according to the size of the machine, and as experience may approve,) and divided into thirteen equal chambers, all being accurately closed before and behind; an opening or window being cut in each chamber on both sides, of such a size as readily to be seen at the stations next adjoining, by the free passage of the light; a sufficient interval between each opening being preserved, to render the windows accurately defined: to make the bright appearance of the windows more conspicuous, every part of the machine may be painted black,—the wheels, shutters, frame, and even the whole inferior semicircular space.

The ropes that move the wheels, (by which the shutters are made to close the window required,) are carried down into the observatory by appropriate pulleys, and through openings in the lower beam and shoulder of the shaft. These ropes are divided accurately by spaces equal to the thirteenth part of the diameter of the wheels, and are to be numbered 1, 2, 3, 4, &c. corresponding with the thirteen chambers in such a way, that the two ropes which go to one wheel may have the order reversed, so that by bringing down a particular number of the rope to a fixed point on the shaft, we shall know the corresponding window above, is closed by the shutter, connected with the wheel we are turning. The double numbering of the ropes may, perhaps, be obviated, by attaching to one of them a weight sufficient to draw back the shutter to its point of departure; in which case, the shutter will always remain below the range of windows, unless the opposing rope is pulled by the observer, to the point desired.

To employ this telegraph by night (which, however, is rarely requisite), lamps are placed within the chambers, and the intensity of the light hereby produced, is greatly augmented by lenses fitted to the windows. These might be fixed in a semicircular frame, which could be made to sink during the day below the range of windows. If used by night, four shutters must be employed (two on each side) to obstruct as necessary, the light from the adjoining station on either side.

Over the central window of the telegraph is fixed a sheet iron or copper parallelogram, or tower, six, eight, or ten feet high, of equal width with the machine. This is divided into three or more chambers, the lowest one blank, for the reception of blinds running in appropriate grooves, and falling into the blank chamber by their own weight. They are raised by means of ropes passing over pullies in proper situations, and running down into the observatory. The upper chambers of this case have circular openings or windows, of two or more feet in diameter, which are closed as occasion requires by the above mentioned blinds. At night, lamps are to be fixed in the chambers; and, as one or other light, or the whole number, are obscured, so signals are constituted distinct from those of the telegraph itself. The United States' flag may surmount this tower, and may, if necessary, be made accessory to the general communication.

It is scarcely necessary to mention, that the machine must be sufficiently elevated above all adjoining buildings, so as to be conspicuous in every point to which it may be revolved.

When the machine is fixed permanently in a large town, the building on which it is elevated would be perhaps best constructed of an hexagonal or octagonal form, by which means, as many windows of observation may be connected with the observatory; and, if the room is made of brick or stone, it might be easily vaulted, so as to secure it from fire, (which might destroy the machine above,) and render the circles of rotation in the roof, more solid and secure.

The rotation of the machine is easily accomplished in the observatory by one or two persons, by means of an horizontal bar passing through the shaft.

The advantages of this telegraph, I conceive to be

1. Its simplicity; for by the proper obscuration of the thirteen chambers of the semicircle, all the letters of the alphabet, &c. may be signified. It is, I think, capable of being effected with one shutter only, in place of two, as above recommended, even *without* the upper case or tower, but certainly in conjunction with it. I have not, however, matured the plan completely.

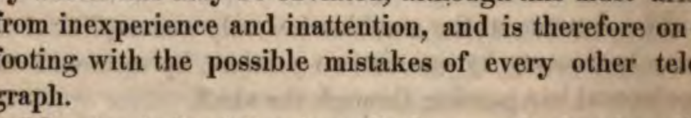
2. By its capability of rotation, one machine is adequate to convey signals from a centre to every point of the compass; and hence is peculiarly adapted for large towns, especially for our seats of government.

3. By the mutations of which it is capable, it is impossible to detect the intelligence communicated; for signals can be equally adapted to figures, letters, words, or sentences, and the key may be changed ad infinitum.

4. By a slight modification it would probably be well adapted to vessels of war, as a permanent or temporary appendage to one of the upper yards. Six chambers, in place of thirteen, would, I think, supply every requisite signal, particularly with the aid of a few flags; or the upper case or tower alone, with an increased number of circular windows might readily be elevated at the summit of the mast, or be carried out to the extremity of a yard, as the steering sails are, by means of a boom, and no doubt by the changes that could be made, would answer every object at sea.

I have gone upon the supposition, in the account of the above machine, that all the windows in the semicircle are exactly similar; as I have heard it objected, that some difficulties might arise in the signals by a mistake in the observer of the chamber closed, I shall point out a mode by which this may be obviated, although this must arise from inexperience and inattention, and is therefore on a footing with the possible mistakes of every other telegraph.

My plan is the following: To have each chamber differently constructed on each side the central one. Thus suppose the central chamber to be circular, the others might be as follow:



From the great difference between each, it can scarcely be supposed that chambers thus formed, if three, four, or five feet large, would not be sufficiently conspicuous at the greatest distance that telegraphic signals are communicated. It must be persons totally unfit for the situation, who could not easily acquire a knowledge of the chamber obscured. I say nothing further on this point, since experience perhaps is required to know exactly what figures are best adapted for distant view; and it is only general principles I propose to establish throughout, which may serve as foundations for practical experiments.

I shall now equally in a general point of view, give an idea of the manner of making or rather constituting the signals, since it will altogether depend on the arrangements agreed on in the key of the communications.

I shall suppose the hour of communication arrived;—(it will probably be best to have certain fixed periods of communication;) the signal of commencement is hoisted throughout the line, successively, from first to last, none withdrawing his, until the station in advance has elevated it. This signal might consist of the flag of the Union, were it not for the wind being often unfavourable to its proper display: hence, perhaps, it will be better to blind the upper chamber of the parallelogram or tower. This signal being made and withdrawn, the lower chamber may be darkened to signify figures, or both chambers may be darkened to imply letters, as the medium of correspondence. These preliminaries being settled, requiring no more time than is requisite to hoist the blinds, and ascertain if the next in succession has answered them, the same chambers serve now another purpose in the progress of correspondence. Thus the upper chamber closed, implies the signal of error, and, of course, a repetition of

Explanation of the Plate.

Fig. 1, Plate 3,—Geometrical elevation of the telegraph, seen from behind, with a perpendicular section of the chamber of observation. One half of the telegraph and frame is seen covered with black cloth, or painted, leaving only the windows of the chamber permeable to the passage of light. This back part of the telegraph chambers, when complete, is equally covered with the front. It is left unfinished here to permit the view of the different chambers.

ABCD, the frame on which the telegraph is raised.

EF, the semicircular frames of iron or copper, subdivided into 13 chambers.

G, the rods or radii supporting it on the wooden frame.

H, the shaft passing through the lower beam CD into the observatory, and playing in the socket *a*.

I, the shoulder attached to the shaft, and fixed firmly in the beam, its lower part playing in a circular opening of the roof. The ropes *b*, *c*, are seen descending from one of the wheels, through the perforations of the beam and shoulder.

dd, iron castors or rollers sunk into the beam, on which the telegraph and frame rotate in horizontal circles on the roof.

K, the iron cap on the top of the shaft, branching out into the arms which support the axes of the wheels, the inner one of which,

L, is here seen, having a shutter *e*, morticed firmly into its interior surface. The other shutter *f*, is seen covering, on the off side, one of the chambers of the telegraph, and is attached to the returning arm of the solid axis. This is more clearly seen in fig. 2.

M, the tower or parallelogram raised above the telegraph; divided into three chambers, one of which is blank, to receive the shutters covering the windows, which fall back by their own weight. The ropes which hoist them are seen passing over pullies, and down into the observatory, through the perforated beam and shoulder.

N, a flag, surmounting the whole, to be occasionally used for signals.

O, the observatory.

P, the signal officer.

Q, the workman employed in pulling the ropes to constitute the signals, as ordered by the officer at the telescope.

The ropes are divided into 13 spaces, corresponding with the 13 chambers of the telegraph; by pulling either of which to a fixed point, such or such a window is obscured.

Fig. 2. *a*, the lower beam of the frame, with the shaft *b*, passing through it, and having the shoulder *c*, connected: The openings for the ropes are here seen in them.

d, the iron cap; *e e*, the arms supporting the axes: *f*, the solid axis passing through the hollow axis *g*; *h*, the upright, and returning parallel arm of the solid axis, playing on the periphery of the hollow axis with a friction roller *i*.

k, the arm of one of the shutters attached to the returning arm.

l, the inner wheel, (with a shutter morticed into its interior surface,) attached to the rim of the hollow axis.

m, the outer wheel, fixed to the solid axis, by which the shutter *k* is worked.

Fig. 3, an enlarged view of one of the castors on which the telegraph rotates.

Fig. 4, section of the shaft and shoulder, showing the manner of constructing the holes for the passage of the ropes, by which they work freely, without being impeded by the rotation of the machine.

NO. 21.

Description of a Method of connecting Iron Bars, and coating them with Lead, so as to form solid Pillars for Light Houses on Rocks covered at High Water, and to defend them from Corrosion. By Captain JOSEPH BRODIE, *of the Royal Navy.*[*]

(With an engraving.)

FIG. 1, Plate 4, A, shows four rods of cast iron, composed of a number of pieces two feet long, rivetted together in a manner explained by the plate, so as to produce the effect of one bar of the thickness of the whole. *B*, a tube of cast iron, formed from a number of separate pieces, each about ten inches long, and which, when placed round the iron rods above mentioned, and then screwed together, form a mould, into which the melted lead is to be poured, to coat the iron rods. C. A portion of the rods covered with the melted lead, so as to form a cylindrical pillar apparently of lead, the iron being perfectly coated therewith.

Fig. 2. D shows the manner in which the hollow cylinder is formed to any length required, by the junction of a number of semi-cylinders rivetted together and fitting each other. E, the side flanges screwed close together. F, the end flanges also screwed together, as prepared for the melted lead.

After a certain portion of the iron rods are coated with lead, the lower parts of the tube are taken off and placed higher up; by which repeated changes, a few tubes will answer the purpose to coat any length of the iron rods.

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[*] Nicholson, vol. 11, p. 108. Communicated to the Society of Arts, (Memoirs. MDCCCIV. 258.) who voted him the gold medal.

NO. 22.

Description and Use of a Sea Log, and Sounding Machine, invented by Mr. EDWARD MASSEY, *of Hanley, in Staffordshire.*[*]

(With an engraving.)

TO the nautical reader the advantages resulting from a log, that will give a dead reckoning free from error, or nearly so, must be sufficiently obvious; and to others it would be superfluous to point them out. The principle, on which Mr. Massey's patent log is constructed, is not new; but every application of it to practice has been found defective, and this is the difficulty the patentee has had to surmount. To understand the manner in which it acts, see Plate 4, where *a*, fig. 3, is that part of the log which registers the distance sailed, and is therefore called the register; it contains within itself a set of wheel work, which operates upon the fingers of the several indices, 1, 2, and 3. *b* is the rotator, a hollow cylinder, made air tight, and so nearly of the same specific gravity as water, as to float when drawn forwards with the velocity of mere steerage way. On this rotator are fixed four vanes placed obliquely. It is then fastened to the register by a cord, *c*, about six feet long:[†] to the loop hole at the other end of the register is secured another line, *e*, of sufficient length to extend beyond the eddy of the vessel's wake.

The finger on the index 1 revolves once while the log moves forward one mile; that on the index 2 moves once round in going ten miles; that on the index 3 makes one revolution when the distance sailed is one hundred miles. When the machine is to be used, all the fingers of the indices are set to 0, and both register and rotator committed to the water.

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[*] Nicholson, vol. 21, p. 245.

[†] This cord is shown scarcely one tenth part of its proper length in the engraving: it would have been an unnecessary extension of the plate to represent it otherwise, as it may so readily be conceived.

As the vessel moves forward, the log must follow, and from the obliquity of the vanes it is evident the rotator, *b*, must revolve quicker or slower, correspondent to the ship's velocity. This rotatory motion is communicated by the cord *c* to the universal joint *d*, connected with the wheels, which consequently revolve with the rotator and cord, and thus the actual space passed through, in any given time, is registered on the indices.

Every occasional or momentary acceleration or retardation of the vessel, from irregularity of wind, or other causes, which are either altogether passed over, or very vaguely guessed at, in general, are accurately registered on this machine, which not only gives the actual rate of sailing, but the actual distance sailed, since the last inspection.

A very little reflection will convince any observer of the great superiority of this machine over all others which have been hitherto introduced.

It may appear rather presumptuous to criticise the labours of Smeaton, and many others, whose endeavours were not crowned with complete success: but it is necessary to point out where their plans failed, in order to prove the very superior advantages of Massey's log; for though some of the machines answered their purposes tolerably well under certain circumstances, none of them were nearly correct under all circumstances. Some were erroneous when the ship moved less than four miles in the hour, and others became so when the rate was increased.

In most of the former inventions, the first mover was a spiral, or a rotator in the shape of a Y, and was generally attached to a register kept in the ship; and as it was absolutely necessary, that this first mover should be out of the wake of the vessel, it had a length of fifty yards of cord, or more, to carry round with it every time it revolved. The friction caused by this operation was such as to preclude all hopes of accuracy; it was useless in an agitated sea, the rope was very liable to kink, and in fast sailing the rotator would sometimes fly out of the water.* These circumstances rendered it impossible, that the rotator should make the same number of revolutions in passing through a given space, under different velocities; and hence inaccuracy was unavoidable. To get rid of this friction of the long line, the rotator has, in some instances, been enclosed in a cylinder, and a register been attached to the outside. But though the defect of excessive friction was thus surmounted, still greater inconveniences resulted. It may be sufficient to mention, that the cylinder, not presenting itself horizontally in the water, was liable to alter its position whenever the velocity of the vessel was changed, which caused an eddy, or dead water, to remain in the cylinder; and, of course, the rotator was liable to err, in proportion as the cylinder lost its horizontal position.

After thus hinting at the imperfections of other previous methods of constructing logs, it remains to point out wherein Massey's plan differs.

Friction is the principle cause of mechanical theories varying so widely from actual experiment. In some machines one third is allowed for its effect, while the operation in others is nearly suspended, and what appeared very plausible in theory, is found totally useless in practice. Thus the friction of a rope long enough to extend beyond the eddy of the vessel's wake would, in many circumstances, on the old plan, totally impede the action of the rotator.* Under this impression, the friction in Massey's patent log is reduced to almost nothing by the following simple contrivance. The whole log, consisting of the register, a, connecting cord, *c*, and the rotator, *b*, is committed to the water, by a log line of sufficient length to reach beyond the eddy of the vessel's wake. As the ship moves forwards, the rotator, and cord, *c*, between it and the register, revolve and set the wheels into motion; nor has the roughest sea been found to prevent this action.

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* Smeaton, in the account of his experiments on Saumarez's log, in the Philosophical Transactions, observes on this subject: "Upon making up the account of this run, I found the number of rotations were less by one full third than they ought to have been, compared with the former observations, which afforded me a convincing proof, that this instrument was considerably retarded in quick motions."

The rotator also, in this log, is so constructed as always to preserve a horizontal position, by being made nearly of the same specific gravity as water; which is effected by means of an air tube passing through its centre: an indispensible requisite, which no former machine possessed; and for the want of which, they could not preserve that horizontal position in fast and slow sailing, which is absolutely necessary to obtain any true result.

Another very important improvement consists in the contrivance for regulating the rotator, by which means every rotator revolves once on its axis in passing the same space: as it was found utterly impossible to construct two rotators so exactly alike as stated by Smeaton, without means of adjustment.

To sum up the properties of Massey's patent log, in a few words it may be observed,

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* Smeaton, in the account of his experiments, in the work before quoted, observes: "During this run, I observed that the resistance of the water to the line and plate was very considerable, and increased the friction of the spindle so much, as to prevent it from beginning to turn, till the plate had twisted the line to such a degree, that when it did set a going it would frequently run one hundred and fifty or two hundred turns at once."

1. It will give the true distance sailed, from steerage way, to any velocity with which the swiftest sailing vessel can move.

2. It not only gives more accurately than the common log the rate of sailing, but the actual space sailed through since the last inspection.

3. It is attended with less trouble than the common log, and no mistakes can possibly arise from the result it gives.

It remains to point out one great and desirable advantage, which may very reasonably be expected to result from the use of this log, and that is, a more complete knowledge of the currents in various parts of the ocean, which has hitherto been very imperfectly attained; as it was not possible to know, with any certainty, whether the wide difference found between the real distance, and that given by the common log, was caused by the known imperfections of that method of reckoning, or by the operation of currents.

Dr. Maskelyne, in the same work just quoted, further observes: "There is another argument which adds much strength to the foregoing ones, and greatly enforces a uniform and correct length of the logline, on board all ships; that in many parts of the ocean, especially between the tropics, and near most head-lands, there are considerable currents, which must introduce a fresh error into the reckoning; and if this error should happen to combine with that already produced by a wrong length of the logline, as it may as well as not, it is not easy to say how far the total error of the reckoning might go, or to what inconveniences or dangers the ship might be exposed on that account. But if the just and proper length of the logline were used on board of all ships, they would be then liable only to the errors of the currents themselves; and even these, as far as they are constant and regular, might be found out and ascertained, from the journals of several ships, which would then agree much nearer with one another." And Smeaton observes, that "it is for want of a means of measuring the way of a ship through the water, (and this compared with other check observations,) that the drift and velocities of the principal currents have not already been determined."

But admitting the common logline and glass were perfectly uniform in each ship of a fleet, yet the result would still be too erroneous to expect this very desirable knowledge of the currents to be derived from a comparison of the several journals. Massey's patent log holds out, however, more than a probability of effecting this important end. It appears by a letter from captain Whittle, of the Lord Nelson, that he found the distance run from the island of Ila, to Saint Johns' harbour, Newfoundland, by Massey's log, to agree with the known latitudes and longitudes of both places, within eight miles. Now had he sailed in company with several other ships, supplied with the same log, which had kept tolerably well together during the whole voyage, and it had been found (which is more than probable) that all their reckonings corresponded with his; the difference between the true distance, and the distance given by the log, might with the greatest propriety be ascribed to the operation of currents; the existence of which would consequently be discovered, as far as related to those seas.

The importance of obtaining true soundings at sea must be admitted by every seamen; and it is rather singular, that no other method than the common lead has hitherto been brought into use; as its imperfections are very generally acknowledged.

Many vessels have been lost, by depending upon the soundings taken in the usual way. The difficulty of obtaining the true perpendicular, and the uncertainty as to the exact moment when the lead strikes the bottom, upon which the accuracy of the result depends, must always prevent the possibility of obtaining the true depth, while the ship has any considerable way upon her. Indeed, it has been acknowledged by experienced seamen, during some experiments, made at various times, in the river Mersey, that they could not depend upon the common lead, when going five or six knots in the hour, in ten or twelve fathoms of water. When the depth is considerable, the vessel must be hove to, which is an operation attended with great loss of time, and sometimes considerable injury to the sails; and during a chase, this inconvenience must be particularly felt.

Massey's sounding machine is as great an improvement upon the common lead, as his patent log is upon the common log. A rotator on the same principle as that to the log registers the perpendicular descent of the lead, without any respect to the length of line paid out, which, in the usual method of taking soundings, is the chief guide to the mariner in judging of the perpendicular depth, and is apt to deceive him much.

True soundings may be taken with this machine in thirty fathoms water, without the trouble of heaving the vessel to, although she may be going at the rate of six miles in the hour. True soundings may also thus be obtained in very deep water, where it is not possible to take them by the common lead.

This sounding machine is on the same principle as the log, for it is evident, that, if the end *e* of the register, *a*, (*fig.* 3,) were projected into the water, and suffered to descend, the rotator would follow, and register the exact depth, as well in a perpendicular, as in a horizontal position.

But though the principle of the two machines is the same, their construction necessarily differs considerably, as will be perceived on reference to the plate.

Fig. 4, represents the sounding machine. *a* is the sounding weight, containing a register, 1, 2, with two dials: the hand of the dial 1 makes one revolution when the weight has descended twenty fathoms, the other revolves once when the descent amounts to five hundred fathoms. A rotator, *b*, similar to that attached to the log, communicates with the wheel work of the dials 1, 2, by means of the rod *c*, on which there are three universal joints, 3, 4, and 5. This rod is supported during the descent of the weight, by the drop, *d*, at the end of which is a fork, 6, and a friction wheel, 7.

When the machine is to be used, a sounding line is fastened to the ring, *e*; and one of the vanes of the rotator is slipped into the spring 8: the rotator will then be in the position indicated by the dotted lines, *x*. The indices must be set at 0, and the cover or lid, *f*, be shut. The machine must then be projected perpendicularly into the sea. As soon as it reaches the surface, the resistance of the water forces the dotted rotator, *x*, out of the spring 8, and it assumes its perpendicular direction as represented by the rotator *b*. As the machine descends, it is evident the rotator will revolve, and its motion be communicated freely past the friction wheel 7, and the universal joint 5, to the wheel work of the dials 1, 2, and thus indicate the space passed through in fathoms. When the machine has arrived at the bottom, the rotator, as it is no longer buoyed up by the reaction of the water, will fall to the bottom, quitting the fork of the drop *d*, which will also fall from its horizontal position, and in its descent, by means of the locking rod 9, prevent the rotator from revolving as the machine is drawn up. When at the bottom, the rotator will be in the position of the dotted lines *y*.

This machine, simple in its construction, and scarcely more liable to accident than the common lead, ascertains, with the utmost precision, the perpendicular depth, by the mere act of descent through the water. No mistake can arise from that common source of error, the drift or leeway of the ship during the time of descent; nor does an operation of such importance depend upon the uncertain sensation caused by the lead striking the bottom, on which the accuracy of the common log altogether depends, and which, it is well known, frequently and materially misleads the best seamen: for though a thousand fathoms of line were paid out, in the smallest depth of water, no inaccuracy could arise, as the perpendicular depth, at the point of heaving, would be registered on the index. The only inconvenience experienced would be the additional labour necessary for hauling in the excess of line. The most inexperienced persons may use this machine, without risk of error, in the most turbulent sea, and during the night.

The advantages already enumerated would render the sounding machine of great importance; but there are other properties of still more consequence.

To heave a ship to, in order to obtain soundings, on a lee shore, in stormy weather, is a very disagreeable operation, attended with much trouble, and loss of way; also with considerable danger to the ship's sails; indeed, it would often, under such circumstances, be attended with great hazard to the safety of the ship. To avoid these unpleasant consequences, the master sometimes adopts a measure, which he conceives to be the less exceptionable alternative, by running on without sounding at all.

To prove how much inconvenience and danger are avoided by Massey's lead, it is enough to state, that soundings may be taken in depth from sixty to eighty fathoms, while the ship is under way, at the rate of three miles an hour; and as the rate of sailing may be still materially reduced, without entirely stopping the vessel, or altering her course, so may soundings be had, to any depth required, while she is under way.

In order more clearly to show the superiority of this machine, and make it apparent, that the quantity of stray-line veered out does not at all affect the truth of the result: suppose the common lead thrown from the mizen chains of the ship, which may be represented by the point *a* of the triangle *a b c*, (fig. 5,) and that the ship has moved forwards through the space equal to the line *b c*, while the lead has descended through the line *a c*; it is evident, that it is impossible, in this case, to ascertain the exact depth, as a quantity of line, equal to *a b*, would be paid out, whereas the true depth is equal only to the line *a c*, which is much less. But the case is very different when the patent sounding machine is used, as the operation ceases when it has reached the bottom; nor is the strayline, *a b*, whatever its length, at all taken into the account.

It has been found extremely difficult, and sometimes impossible, to obtain soundings in very deep water with the common lead, which may perhaps be thus accounted for. The common line which is used for sounding, though, if left to itself, it would sink in water, yet its descent would be much slower than that of the lead, separately; it consequently follows, that the lead must be so much impeded by carrying the line with it, that when it does reach the bottom, there will be scarcely any sensible check to enable the seaman to know the precise moment. Indeed, if he can ascertain even this to a certainty, he still cannot depend upon the truth of his soundings; for if there be the least drift or current, the line itself will assume a curve, similar to that of the line of a kite in the air. These two causes will always operate against the perfection of the common mode of sounding.

After so fully describing the principle of the patent sounding machine, it is scarcely necessary to prove, that it is liable to neither of the foregoing objections; and it may be sufficient to say, that, as it will certainly find its way to the bottom, if a sufficient portion of stray-line be allowed to guard against its being checked in its progress, and the certainty of its having reached the bottom may be ascertained by the arming, there can be no doubt of the practicability of its obtaining soundings, in any depth, and no reasonable doubt of their correctness when obtained.

From the construction of this machine, it might be imagined, that the rotator would impede its motion through the water, and that it could not descend so rapidly as the common lead; but during repeated trials, in thirteen fathoms water, in which the rotator was frequently detached, and the lead suffered to descend alone, there was no difference perceptible in the time of their descent, though an excellent quarter-second stop watch was used during the experiment, to detect any change. The following table shows how very uniformly the times of descent corresponded with the depths in fathoms, during a series of trials made on the river Mersey, with the patent lead, weighing fourteen pounds.

The manner of conducting these experiments was such as is deserving of perfect reliance. Two pilots, of well known ability and experience, were employed: one threw the lead, and the other, the moment he found, by the slackening of the rope, that the weight had arrived at the bottom, cried, 'stop,' to a third person who held the watch.

Time of descent.		Fathoms.	Time of descent.		Fathoms.
2	seconds	2½	7¼	seconds	11½
2¼	———	3	7¼	———	11½
3	———	4	7¼	———	11½
5	———	8	7½	———	12
5½	———	8½	7¾	———	12¾
6	———	10	8	———	13
6	———	10	8¼	———	13½
7	———	11¼	6	———	10

Taken when under sail, at upwards of five knots in the hour.

Several captains and masters in the navy have made trial of the log and sounding machine, and given very favourable reports of their performance. Of these the two following may be selected as specimens.

San Josef, 12th December, 1806.

Having several times, and in different depths and rates of sailing, tried Mr. Edward Massey's patent sounding machine, which is, in my opinion, a most excellent invention, as correct soundings were gained in fifty-five fathoms, with a strong breeze, going six knots, by only passing the lead to the quarter-boat, attaching a hand lead about thirty fathoms from the machine, (which I think, is in such cases necessary :) and about ninety fathoms of line out: at another trial, to compare the old with the new method, going five knots and a half, correct soundings were ascertained by the machine in fifty-two fathoms, by passing the line to the main-chains, when we could barely get the depth in the old way, by carrying the lead to the spritsail-yard, notwithstanding the immense length of a first rate, and daylight in our favour; and not even then, if we had not had knowledge of the depth nearly, that being a check or caution not to give too much line off the reel, there being no time to gather in the slack, which would be the case were we sounding in an unknown place, by the old method. The invention is the more valuable, as the process is the most simple, the whole being understood, by seeing it once in use.

I therefore consider it a valuable improvement in navigation; as in frequent, and various cases, soundings could not be gained without it. The advantages are many, such as in chase, or being chased; on a lee-shore, or doubtful of it; and to save time in running for the desired port.*

R. J. NEVE, Captain.

N. B. It will be necessary in the practice of the new method of sounding, to have line of different sizes, in proportion to the depth of water; as by the ship passing at the rate of eight or ten knots, it will require the best of lines to haul in the lead, and should be made of a much superior quality to those at present supplied to the navy.

H. M. S. San Josef, in Torbay, 12th Dec. 1806.

Sir—In obedience to your orders, we have been particular in attending to the use of Mr. Edward Massey's Patent Log, and from every opportunity that offered during our cruize, we are strictly of opinion, that it has the merit of accomplishing the end for which it is intended.

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* The honourable Navy Board have adopted the sounding machine for the use of his majesty's navy, and have favoured the inventor with an order for five hundred machines.

On some trials made with it, and the common log, they perfectly agreed, at other times they differed a little, but last night bearing up for Torbay, with a run of eighty miles in squally weather, there was a difference of nine miles: but agreeably to our reckoning the patent log was perfectly correct; we therefore consider it an important improvement in navigation, and the more so, as the instrument is simple and easy to be generally understood.

The chief things necessary to be observed are to secure the tow-line as near the surface as possible, to prevent the machine from quitting the water in an agitated sea, and fast sailing, and not to be less than sixty fathoms long in a first rate, to prevent it from being affected by the eddy of the ship's wake. We are, &c.

R. J. NEVE, Captain.
THOMAS MOORE, Master.

To sir CHARLES COTTON, bart. viceadmiral of the red, &c.

No. 23.

On Preserving Seeds of Plants in a State fit for Vegetation. By JOHN SNEYD, *Esquire, of Belmont, Staffordshire.**

MANY years ago having observed some seeds which had got accidentally amongst raisins, and that they were such as are generally attended with difficulty to raise in England after coming in the *usual way* from abroad, I sowed them in pots, within a framing; and as all of them grew, I commissioned my sons, who were then abroad, to pack up all sorts of seeds they could procure in absorbent paper, and send some of them surrounded by raisins, and others by brown moist sugar; concluding that the former seeds had been preserved by a *peculiarly favourable state of moisture* thus afforded to them. It occurred, likewise, that as many of our common seeds, such as clover, charlock, &c. would lie dormant for ages within the earth, well preserved for vegetation whenever they might happen to be thrown to the surface, and exposed to the atmosphere, so these foreign seeds might be equally preserved, *for many months at least*, by the kindly covering and genial moisture that either raisins or sugar afforded them: and this conjecture was really fulfilled, as not one in twenty of them failed to vegetate; when those of *the same kinds*, that I ordered to be sent lapped in common parcels, and forwarded with them, would not grow at all. I observed, upon examining them all before they were committed to the earth, that there was a prevailing dryness in the latter, and that the former looked fresh and healthy, and were not in the least infested by insects, as was the case with the others. It has been tried repeatedly to convey seeds (of many plants difficult to raise) closed up in bottles, but without success; some greater proportion of air, as well as a proper state of moisture, perhaps, being necessary. I should also observe, for the satisfaction of the Society, that no difference was made in the package of the seeds, respecting their being kept in husks, pods, &c. so as to give those in *raisins* or *sugar any advantage over the others*, all being sent equally guarded by their natural teguments. Whether any experiments of this nature have been made by others, I am totally ignorant; but I think that, should this mode of conveyance be pursued still more satisfactorily than I have done, very considerable advantages might result from it.

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* Tilloch, vol. 3, p. 30. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. 16.

No. 24.

A quick and easy Method of converting Weeds and other Vegetable Matter into Manure. By Mr. Brown, *of Derby.**

I BEG leave to communicate to the Society, and, if thought worth notice, by them to the world, a composition for manure. Fearful it would not answer the purpose so fully as I could wish, I deferred it from year to year; but I now find, both by numerous trials made by my friends, as well as myself, the very great utility of the composition, as well as its cheapness, with the capability of its being made in any situation and in any quantity. The mode of making it is as simple as, I trust, it will be found productive. It is nothing more than green vegetable matter, decomposed by quick or fresh-burnt lime. A layer of the vegetable matter about a foot thick, then a very thin layer of lime, beat small, and so on; first vegetable, then lime, alternately. After it has been put together a few hours, the decomposition will begin to take place; and unless prevented, either by a few sods, or a forkfull of the vegetables at hand, it will break out into a blaze, which must at all events be prevented. In about twenty-four hours the process will be complete, when you will have a quantity of ashes ready to lay on your land at any time you wish. Any and all sorts of vegetables, if used green, will answer the purpose; say weeds of every description. They will doubly serve the farmer, as they will not only be got at a small expense, but will in time render his farm more valuable, by being deprived of all noisome weeds.

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* Tilloch, vol. 3, p. 32. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. 16.

But if this composition answers the purpose, as I flatter myself it will, a very short time will see almost every weed destroyed, which supposing to be the case, I have made my calculations with clover, grown for the purpose; for instance, I will take one acre of clover, which at one cutting will produce from fourteen to eighteen tons of green vegetable matter, and about three tons of lime: this, when decomposed by the above process, will yield ashes sufficient to manure four acres, the value of which I estimate at something under four pounds; the clover, according to the value of land here, I will say two pounds, which, take the average of the kingdom, is too much. The lime I will also say two pounds; but that will vary, according to the distance it is to be fetched. Take them together, I think will be about the average value. Now if this is the case, and as far as I have been able to try it I find so, how valuable must it be to the community in general! If it answers the purpose, I shall feel myself much obliged by the Society making it as public as they possibly can.

The vegetables should be used as soon after they are cut as possible, and lime as fresh from the kiln as the distance will allow of; as on those two circumstances depends the goodness of the composition.

NO. 25.

Observations and Experiments on Staining Wood. By Professor BECKMANN.*

THE oldest inlaid works now extant are preserved in Italy, and the most highly esteemed of these are those made by John of Verona, a monk and cotemporary of Raphael, who was born in 1470, and died in 1537. He was invited to Rome by pope Julius II, in order that he might add to the splendour and magnificence of the Vatican; and he left behind him many specimens of his art at Sienna, Naples, and other Italian cities. The works of this artist, on account of the variety and beauty of the stained pieces of wood employed in them, are still celebrated among connoisseurs, and preferred to all new works of the like kind. It is, however, to be lamented, that the processes used by John of Verona are at present altogether unknown, though the wood he employed was chiefly of European growth. Veneered or inlaid works are now so much in vogue, that there are few houses in which some of the furniture is not ornamented in this manner; and the sums of money expended every year for different kinds of foreign wood, necessary to supply this luxury, is very considerable. These woods are imported chiefly from India by the English, Dutch and French; and some of them are of more value than the best copper, the filings of which might be employed to make imitations of them. That narrow district alone on the Rhine between Darmstadt and Heidelberg receives annually for walnut tree wood the sum of ten thousand florins. Since mahogany furniture however began to be used, our cabinet makers have made scarcely any thing else than common works, because we are accustomed to purchase from the English, not only the materials, but also the works themselves; so that the time may come when no workmen of this kind will be found in Germany: on that account, it is well worth the trouble to make experiments on the staining of our own wood, in order to render them equal, if not to all foreign woods, at least to some of them, since many things can be coloured in that manner which are harder and more compact than wood. The labours of Dufay in this respect are well known; and it appears by some papers of his among the Memoirs of the Academy of Sciences, that rock crystal, when exposed to the vapour of arsenic and antimony, assumes a red colour. Count de Borch's description of the method of staining marble in Italy may also be mentioned; and the process by means of the smoke of oak chips, which is employed by the Dutch for colouring their tiles and earthen ware. Canes are prepared for use in India, by dipping them in quicklime. That hard compact wood brought from America, and particularly Guiana, which, on account of its variegated and spotted appearance, is called *Bois de Lettres,* and which Aublet, who gives it the name of *Piratinera Guianensis,* much admired, has its whole surface stained by the Indians with the blackest and most durable colours.—As the art of staining wood seems at present to be nearly lost, the following experiments may be of some utility to artists:

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* Tilloch, vol. 3, p. 54. From *New Transactions of the Royal Society of Gottingen*, vol. 6.

1. *By Means of Oils and Acids.*

Experiment I.—A square piece of plane-tree wood, a line in thickness, was put into pounded dragon's blood from the Canaries* mixed with oil of turpentine, and placed over the fire in a glass vessel. The wood slowly assumed the colour, even before the spirit was volatilized. After more than an hour the vessel was taken from the fire and suffered to stand the whole night, when the wood appeared of a mahogany colour, not merely on the surface, but also in the interior parts. The denser fibres were somewhat less coloured, but this, instead of injuring the beauty of the wood, rather added to it. The red dye can be made stronger or weaker by taking a greater or less quantity of dragon's blood, and by a greater or less degree of digestion and boiling. The wood of the plane-tree was chosen for this purpose, because it can be easily sawn and polished; because it has a white colour; is neither too hard nor too soft; because it neither contracts nor warps; has beautiful white spots with veins that cross each other; and because artists who make inlaid work have long attempted to colour it by staining. The wood, when stained, can very easily be freed from the dragon's blood adhering to it, by means of rectified spirit of wine. The spirit of turpentine makes the wood more compact, and renders it more susceptible of a fine polish.

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* That from Madagascar is of an inferior quality.

II. Gamboge, dissolved in spirit of turpentine, gave to the whole surface of a small piece of wood a most beautiful shining golden yellow colour. The fibres and veins, on the other hand, had assumed a colour inclining a little to red. A piece of the wood of the pear tree assumed a darker colour, somewhat approaching to green, and which in part was nearly an olive colour. Different colours may therefore be obtained by employing different kinds of wood..

III. One part of dragon's blood, two parts of gamboge, with spirit of turpentine, gave to the wood of the plane tree or beech, according to the mixture of the colours and the nature of the wood, a remarkable variation of dyes. A bit of beech wood seemed always to assume a blackish yellow colour; and was thoroughly stained, when moderate heat was kept up for a sufficient length of time.

IV. Distilled verdigris (crystallized acetite of copper) could not easily be used in the above manner, as its colour is too much changed by oil and fire, as is known to those who employ it as a pigment. The olive colour also does not penetrate to the interior part of the wood.

2. *By Means of Spirit of Wine.*

Experiment I.—When dragon's blood and gamboge were merely dissolved in spirit of wine, the extract was not sufficiently strong, and the dye was of no use. The process, however, succeeds when the spirit of wine has been long boiled over a slow fire, till it is almost evaporated. The piece of wood appears then of a dark red colour, which is improved if the wood be washed in pure spirit of wine. But the colour is never so bright as that produced by means of an oil.

II. Gamboge with spirit of wine gave to wood in this manner a yellow, and gamboge and dragon's blood a yellowish red, colour.

3. *Experiment with Wax.*

White wood boiled in spirit of wine, to which, when it began to boil, wax was added, could not be made to assume the green or the red dye, even in its small cross veins, which were exceedingly porous.

4. *Experiments with dissolved Salts and Metals.*

The following experiments with these substances, which have already been described by Macquer, seemed to be most successful.

Experiment I.—A solution of common alum (sulphate of alumine) penetrates exceedingly well into wood which has been digested in it; so that hopes may be entertained of something being effected by it, as the white colour of every kind of wood becomes whiter by solutions of saline substances: this may be of great use to artists.

II. Wood soaked in a solution of gold assumed a red colour, but the inner part was only of a yellowish red.

III. Distilled verdigris dissolved in vinegar stained wood green, but the colour could never be brought to a grass green.

IV. Wood which has lain a long time under water becomes black, as experience shows, and looks as if charred. It, however, loses none of its toughness or compactness; and many trees dug up in Holland from the turf earth are employed there for ship-building. This effect of the sulphuric acid on wood gave occasion to the following experiment. Pieces of different kinds of wood, of considerable thickness, were placed in the sulphurous acid. In half an hour the whole surface of them was covered with a yellowish scurf, and the wood itself had the appearance of being charred. When washed in water, and exposed some hours to the open air, it was observed that the black colour had penetrated still farther, that the interior part only retained the natural colour, and that the wood was exceedingly close and compact. After this wood had been several times rubbed over with the oil or spirit of turpentine, it became harder and firmer, so that it could receive the highest polish; by which means the colour was rendered more agreeable. This process may be readily employed by artists, as it is easy, and does not require much expense.

V. Another black dye for staining wood, which succeeds extremely well, and may lead to other useful experiments, is that formed with liver of sulphur (sulphuret of potash) and metallic solutions. As the sulphurized hydrogen gas is so subtle that it penetrates the closest bodies, it might readily be conjectured that it would easily give a black colour to wood, if the latter could any how be made to imbibe it with a metallic solution. Pieces of different kinds of wood were placed, for several days successively, in a solution of acetite of lead, and a solution of silver, copper, iron, and other metals; after which a solution of arsenical liver of sulphur was prepared in the following manner: One part of the arsenical liver of sulphur was mixed with two parts of clear quicklime, in a porcelain vessel, over which was poured six or eight parts of boiling water. The solution was then poured off, and the wood which had been impregnated with the above metallic solutions being placed in it and suffered to remain several days, the vessel being closely shut, it assumed a black colour. The solution of acetite of lead produced the greatest effect; that of silver next, and those of the other metals least of all. Spotted wood, and particularly that of the plane, beech, and pear tree, assumed the best colour. It is therefore beyond all doubt that porous wood, such as that of the lime, the elder, &c. could be stained much easier. Though the arsenical liver of sulphur from lime may appear superfluous, as the common, which is prepared from alkaline salts and sulphur, can produce the same effect, the above process however is that which ought to be recommended. This method of staining may be considered as the best, because it impregnates the wood with metallic particles, gives it a hardness susceptible of a fine polish, and secures it from worms. The vessel employed for this purpose must be either of porcelain, stone ware, or glass.

No. 26.

Experiments made to ascertain the Composition of the Swedish Stone Paper or Artificial Slate. By J. G. GEORGI.*

THE invention of Arfuid Faxe, confirmed by many experiments tried at Carlscrona, but not yet communicated to the public, for making a certain kind of artificial slate or stone paper, which may be procured at a small expense, and can be employed instead of common slate, was announced and highly extolled a few years ago in several of the public journals. This substance was said to have a great resemblance to milled or paste-board; to be of an iron-red, white, or yellow colour; to be very hard and stiff, but somewhat elastic; to be subject to no alteration even when immersed in cold water for several months, or when boiled for several hours; to be hardened by exposure to the air; to resist fire a long time, and to burn slowly, after having experienced a great degree of heat, but, when left to itself, to become soon extinguished.

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* Tilloch, vol. 3, p. 158. From the *New Transactions of the Imperial Academy at Petersburgh*, vol. 4.

It is evident, therefore, that this paper may be applied to various economical purposes, such as sheathing ships, which it would not only preserve from rottenness, but also from being destroyed by worms; for guarding from fire the cooking places in ships and powder magazines, and, lastly, for covering houses and wooden buildings. To this it may be added, that plates of this paper fixed on with brass nails, and done over at the joinings with cement, might be covered with some oil varnish in such a manner as to be altogether impenetrable to moisture. We are told also that a small building constructed of wood at Carlscrona, and cased over with stone paper, after being filled with combustibles and set on fire, resisted the effects of the flames and remained unhurt, and that the same experiment repeated at Berlin on a smaller building was attended with the same result. One great advantage of this stone paper also is, that it is exceedingly light, and may in general be procured at a cheaper rate than any other materials for covering roofs, as a plate of it twenty-three inches in length and fourteen inches in breadth costs at Carlscrona only two schellings Swedish.

An invention of such utility and importance ought therefore to excite the ingenious to attempt an imitation of it, in order that, if possible, it may be rendered more public. As soon as I obtained a specimen of it from Sweden, I made experiments to try whether I could not discover the method of making it. The fragment which I first examined was a line in thickness. It was light, easily broken, and possessed all the properties above enumerated. As the analysis by which M. Antic de Servin, at the request of M. Crell, endeavoured to illustrate the nature of this paper, did not appear to me satisfactory, I subjected part of the specimen sent me to a farther examination, leaving a third portion entire for the sake of comparison.

After this examination the red stone-paper appeared to me to consist of, 1. Martial bole, which seemed to be equal to half its weight, and which, on account of the chalk perhaps, or calcareous earth with which it was mixed, produced a little effervescence with acids. Perhaps also there were some particles of another earth, the discovery of which would be of little importance to the object of this research. 2. A vegetable matter of little weight, and similar to that used in the making of common paper. This formed about a fourth part of the weight. 3. An animal glue, similar to that which is procured by boiling from various animal substances: and, 4. A certain oil which seemed to have a resemblance to linseed oil. These substances (3 and 4) made about a fourth part of the weight.

Another specimen which I received from Mr. Cameron, architect to her imperial majesty, contained the same substances in proportions a little different. I was, however, not able to obtain specimens of the white and yellow stone-paper, in which M. Servin observed some traces of martial vitriol (sulphat of iron).

Though I made a number of experiments in order to discover the composition of this slate, I shall here mention those only which were attended with the best success. But, to avoid repetition, I shall first describe that previous manipulation which appeared most convenient.

The red or white bole, carpenters' ochre and chalk, which I employed for this use, were reduced to a fine powder. A pulpy mass of the coarsest kind, procured from a paper manufactory, after being macerated in water, was strongly pressed and weighed out for use. The weight was increased about two thirds by the moisture. In giving an account of the following experiments, I shall mention the weight of this substance as alluding to it when dry.

The glue was dissolved in a moderate quantity of water. I added martial vitriol undissolved, and employed unboiled linseed oil.

For want of a sufficient quantity of raw pulp, I procured, for some experiments, fragments of coarse old paper and bookbinders' shavings, which, after being boiled for about three hours, were much tenderer than that brought from the paper manufactory. A pound of this when wet, after it had been pressed, exceeded that which was dry by about two thirds.

The pulp procured from a paper manufactory being mixed in a mortar with the dissolved gluten, and being afterwards formed into a paste by the addition of the above earths and sulphat of iron, was well beat up in the mortar, and linseed oil then poured over it. The mass, being prepared in this manner, was spread out with a spatula above a sheet of coarse paper placed on a board furnished with a rim or border; another sheet of the same paper was then spread over it, and a second board was placed above all. The whole being then inverted, the board with the rim was taken off, and then the first sheet of paper. The compressed mass was then laid over upon another board sprinkled with sand, and left to dry, after taking the sheet of paper from its other side. Squares made in this manner dry without cracking; but as they become warped, it is necessary afterwards to flatten them, by putting them, with boards between, under a screw-press, and letting them stand for some time.

EXPERIMENT I. I mixed an ounce and a half of the dry pulp from the mill with two ounces of common glue, and, having added red bole and ochre, of each two ounces, obtained a smooth plate.

II. To two ounces of pulp I added four ounces of red bole pulverized, and half an ounce of chalk, with an ounce and a half of glue. The plate thus produced was full of wrinkles and chinks, but tolerably hard.

III. An ounce and a half of pulp, with four ounces of bole, and two of sulphat of iron, produced a plate equally hard, but uneven.

IV. An ounce of pulp procured from old paper and bookbinders' shavings mixed, with half an ounce of glue, an ounce of powdered chalk, two of bole, and an ounce of linseed oil, produced two thin plates smooth and hard.

V. Two ounces of pulp from the mill, with half an ounce of glue, six ounces of red bole and two of chalk, to which were added two ounces of sulphat of iron, and the same quantity of linseed oil, afforded plates that were smooth, but not strong.

VI. An ounce and a half of pulp, with an ounce of glue, and four ounces of white bole, produced a plate smooth, beautiful, and hard.

VII. An ounce and a half of pulp, mixed with two ounces of glue, two ounces of white bole, and as much chalk, yielded a smooth plate as hard as bone.

VIII. An ounce of pulp, one ounce of glue, three ounces of white bole, and an ounce of linseed oil, produced a plate sufficiently perfect and elastic.

IX. A plate which I formed of an ounce of pulp, with half an ounce of glue, three ounces of white bole, an ounce of chalk, and an ounce and a half of linseed oil, was superior to that mentioned in the preceding experiment. This substance retains figures impressed upon it, and, tinged with half a dram of Prussian blue, assumed a blueish-green colour.

X. An ounce and a half of pulp, with an ounce of glue and four ounces of chalk, afforded a plate exceedingly spongy.

XI. An ounce and a half of the same pulp, one ounce of sulphat of iron, and four ounces of white bole, without glue, produced a plate yellowish and spongy.

XII. An ounce and a half of pulp, four ounces of white bole, with an ounce of sulphat of iron, and the same quantity of glue, produced a yellowish plate a little more solid.

I tried several other mixtures; but as the plates they produced were of an inferior quality, I shall not give any account of them. The plates which had been prepared in the above manner I cut into several pieces, and daubed over a specimen of each with boiled linseed oil. The parts covered with the oil assumed a darker colour, and the superficies acquired more solidity, nor were they less capable of resisting fire.

Being desirous of comparing the productions of my experiments with specimens of the Swedish stone paper, I macerated about an inch square of each in cold water. After they had been macerated four months, the specimens prepared with sulphat of iron were considerably swelled, but those made without linseed oil seemed to have scarcely swelled at all. Those, however, which I had daubed over with boiled linseed oil, or linseed oil varnish, exhibited as little appearance of change as the Swedish.

I put a square inch of each of the different kinds upon an iron spatula, together with a like quantity of beech wood, and exposed the whole to a strong heat in the mouth of a furnace. After fifteen minutes the wood began to burn, and in fifteen minutes more was reduced to ashes. The fragments of the different specimens of the stone paper, exposed to the same heat, were in such a state of ignition that they hissed when immersed in water. I, however, examined them with great attention. The fragment of the Swedish manufacture was somewhat black on the surface, and puffed up into small blisters; but did not seem to have burnt, or to have changed its form. The specimens prepared with the sulphat, being more spongy at the edges, burnt; but so slowly, that in those of the worst quality the fourth part was scarcely consumed in the above time. All the rest, inferior in nothing to the Swedish specimen, resisted the fire with equal strength; so that most of them were only a little blackish on the surface, and entirely free from blisters; nor did there appear any difference that could be ascribed to the glue or linseed oil employed, as they were all of the same consistence, and none of them seemed to have been warped by the heat.

I then put some of the same fragments toasted in the fire on a red hot plate of iron, and immediately exposed them for fifteen minutes to a strong heat in the middle of a furnace. The Swedish specimen burnt, and for five minutes emitted a thick smoke; then appeared of a white heat for some time, and at the end of fifteen minutes was converted into three friable cineritious laminæ. The specimen produced by my first experiment burnt in the course of a minute, kept up a flame for three minutes, and in fifteen minutes was converted into a black plate sufficiently hard. Specimens of the second, third, and fourth experiments exhibited the same appearances. A plate produced by the fifth experiment was sooner destroyed by the fire, and appeared friable like the Swedish. A plate of the sixth experiment, which before had been scarcely changed by the fire, bore the last exposure exceedingly well; was scarcely changed in its form and magnitude, continued sufficiently hard, and was only rendered black and as it were scorched. A specimen of the seventh experiment burnt for a whole minute, and became black and friable like the preceding. A specimen of the eighth burnt for two minutes, and then continued black and sufficiently hard. The same was the case almost with the ninth specimen. A specimen of the tenth, though it became black, was however scarcely changed. A fragment of the eleventh experiment burnt with a flame for about two minutes and was converted into ashes; which was the case also with the specimen produced by the twelfth experiment.

Those specimens produced by my fourth, sixth, seventh, eighth, and ninth experiments, seemed to be the best in their external qualities and their power of withstanding fire and water. The same fragments suffered as little from the influence of the weather and atmosphere as the Swedish. The materials for making this article may be readily procured for a small price; and the process is simple, and requires very little time. My specimens indeed were not so neat and elegant as the Swedish; but this inferiority may be obviated by practice and experience: and even in its imperfect state the invention may be of great economical utility.

The cement which the Swedes recommend for filling up the interstices between the squares, and of which I received a specimen of Mr. Cameron, was composed of linseed oil varnish, white lead and chalk, mixed together in such a manner as to approach to a fluid state, that it might more easily insinuate itself into the fissures.

As the chief use of this invention is to cover and incrust houses, I was desirous of trying my production by exposing it to the effects of the weather. I therefore nailed fragments of the Swedish stone paper, and of that made by myself, to a small board; and having daubed over the joinings with cement, I exposed them in the month of August on the top of my house, and in the beginning of April the next year I found they had undergone no change.

NO. 27.

Observations on the Manufacture of the Acetite of Copper or Verdigrise, Verdet, &c. By J. A. CHAPTAL.*

THE acetite of copper is one of the preparations of that metal most frequently used in the arts. It is not only one of the principal resources of painting, but upon many occasions is employed with great advantage in dyeing. Almost all the oxydes of copper obtained by the action of saline substances have a blue colour, more or less inclining to green, and almost all the neutral salts corrode the metal, and produce that oxyde which is called verdigrise. It is sufficient to bring them into contact with the copper, or to immerse the metallic plates in a saline solution, and afterwards to expose them to the air to dry.

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* Tilloch, vol. 4, p. 71. From *Annales de Chimie*, no. 75.

Those acids which oxydate the copper by their decomposition, produce an effect like that of neutral salts. The oxyde is of a soft blueish-green colour; their action is so speedy, that if the copper be exposed to the vapour of them for some minutes, its surface will be immediately oxydated. The oxygenated muriatic acid produces that effect as well as the vapour of the nitric acid, and even those of the sulphuric acid. A phenomenon which cannot escape the eye of an observer is, that the oxydes of copper obtained by fire are very different from those produced by the decomposition of acids on that metal. The colour of them is grey, instead of being green; and when the calcination is continued a long time at a violent heat, they may be concentrated to a red oxyde of a blood colour. This phenomenon was observed by Kunckel in his chemical laboratory.

Saline substances are not the only ones capable of oxydating copper green. All oils and fat matters produce the same effect. Even water, when left for a considerable time in copper vessels, causes an oxydation. But what will appear very extraordinary is, that the greater part of these substances have no sensible effect upon copper, except when cold. Those salts even which corrode that metal when left at rest in vessels, do not attack it in so sensible a manner when in a state of ebullition.

Of all the preparations of copper by oxydation, there is none more valuable than that made by vinegar. All the verdigrise used in commerce is prepared by that acid, and it is at Montpellier in particular and in the neighbourhood, that the manufactories of it are established. In the Memoirs of the Academy of Paris for 1750 and 1753, may be seen a very exact description of the process then followed at Montpellier for making verdigrise; but as that process has been much improved, and as at present the husks of grapes are employed instead of the stalks, a method far more economical, since wine is no longer used, the following account of the manner of manufacturing verdigrise, as now practised, may be of utility to the public.

The first materials used for this purpose are copper and the husks or skins of grapes left after the last pressing. The copper employed was formerly all imported from Sweden; but at present it is brought from different foundries established at Saint Bel, Lyons, Avignon, Bedarieux, Montpellier, &c. It is in round plates half a line in thickness, and from twenty to twenty-five inches in diameter. Each plate at Montpellier is divided into twenty-five laminæ, forming almost all oblong squares of from four to six inches in length, three in breadth, and weighing about four ounces. They are beat separately with the hammer on an anvil to smooth their surfaces, and to give the copper the necessary consistence. Without this precaution it would exfoliate, and it would be more difficult to scrape the surface in order to detach the oxydated crust. Besides this, scales of pure metal would be taken off, which would hasten the consumption of the copper.

The husks of grapes, known at Montpellier under the name of *racque*, were formerly thrown on the dunghill after the poultry had picked out the small stones contained in them. At present they are preserved for making verdigrise, and sold at the rate of from fifteen to twenty livres per *muid*. The preparation of them is as follows: After the vintage is finished, the husks are subjected to the press, in order to extract all the wine with which they may be impregnated, and they are then put into vats, where they are pressed down with the feet to fill up all the vacuities and render the mass as compact as possible. The coverings of these vats are carefully fastened down, and they are preserved for use in a dry cool place.

These husks are not always of the same quality: when the grapes contain little of the saccharine matter, when the season has been rainy, the fermentation incomplete, or when the wine is not generous, the husks are attended with several faults. 1. They are difficult to be preserved, and there is great danger of their soon being spoiled. 2. They produce very little effect, cannot be easily heated, send forth very little of the acetous odour, and make the plates of copper sweat without showing efflorescence on their surface. Independently of the nature of the grapes and the state of the wine, the quality of the husks varies also according as they have been expressed with more or less care. Husks which have not been much pressed, produce a far greater effect than those which have been dried. To explain their different effects, it will be sufficient to observe that their action is proportioned to the quantity of wine they retain, as it is that liquor alone which can pass to the state of vinegar. When the husks therefore are destined for a verdigrise manufactory, care must be taken to express them only weakly, in order to preserve more of their acidifiable principle.

When a sufficient quantity of copper and of husks has been provided, nothing remains but to proceed to the operations, which are generally performed in cellars. They may be performed also on a ground floor if it be somewhat damp, if the temperature be subject to little variation, and if there be not too much light. The first operation is to make the husks ferment, which is called *avina*. For that purpose one of the vats is opened, and the husks are put into two others of equal size, taking care to expose them as little as possible to the air, and not to compress them. One vat full of husks ought to fill two, and to occupy a double space after this operation. In some manufactories the husks contained in a vat are distributed into twenty or twenty-five earthen vessels or jars called *oules*, and which are generally sixteen inches in height, fourteen in diameter at the belly, and about twelve at the mouth. When the husks have been put into these vessels, they are covered by putting the lid merely on the opening without pressing it down. The covers are of straw, and made for that purpose. In this state the husks soon heat; and this change may be known by thrusting the hand into them, and by the sour smell which they begin to exhale. The fermentation first takes place at the bottom of the vessel, and gradually ascending extends itself to the whole mass. It proceeds to 30 or 35 degrees of Reaumur.

At the end of three or four days the heat decreases, and at length ceases entirely; and as the manufacturers apprehend the loss of a portion of the vinegar by the natural effect of a heat too much prolonged, they take care after three days fermentation to remove the husks from the fermenting vessels, in order that they may sooner cool. Those who employ vats remove them into jars, and those who use jars put them into others. Besides the loss of the acetous spirit, too great heat inclines the mass at the bottom of the vessel to become mouldy, which renders it unfit for making verdigrise. Some manufacturers, to increase the effect of the husks, form them into heaps, which they besprinkle with generous wine before they bring them to ferment.

The fermentation does not always take place at the same time, nor with the same energy. Sometimes it commences in twenty-four hours, and sometimes it has not begun at the end of three weeks. The heat sometimes will rise to such a height that the hand cannot be kept in the mass, and the acetous odour is so strong that one can hardly approach the vessels; while at others the heat is hardly sensible, and soon vanishes. There are even instances of the husks becoming putrid and mouldy without turning acid. The fermentation is assisted and promoted by raising the heat of the place by means of chafing-dishes, by covering the vessels with cloths, by shutting the doors, and by airing the mass with more care. The differences in the fermentation depend, 1. On the temperature of the air: in summer the fermentation is speedier. 2. On the nature of the husks: those which arise from very saccharine grapes heat more easily. 3. On the volume of the mass: a larger mass ferments sooner, and with more strength, than a small one. 4. On the contact of the air: the best aired husks ferment best.

At the same time that the husks are made to ferment, a preliminary preparation called *desafouga* is given to the plates of copper which are used for the first time. This operation is not employed for those which have been already used, and consists in dissolving verdigrise in water in an earthen vessel, and rubbing over each plate with a piece of coarse linen dipped in this solution. The plates are then immediately placed close to each other, and left in that manner to dry. Sometimes the plates are only laid on the top of the fermented husks, or placed under those which have been already used for causing the copper to oxydate. It has been observed, that when the operation called *desafouga* has not been employed, the plates grow black at the first operation, instead of becoming green.

When the plates are thus prepared, and the husks have been brought to ferment, the workmen try whether the latter are proper for the process, by placing under them a plate of copper, and leaving it buried there for twenty-four hours. If the plate of copper, after this period, is found covered with a smooth green crust, in such a manner that none of the metal appears, they are then thought fit for being disposed in layers with the copper. On the other hand, if drops of water are observed on the surface of the plates, the plates are said to *sweat*, and it is concluded that the heat of the husks has not sufficiently subsided. They consequently defer making another trial till the next day. When they are assured that the husks are in a proper state, they form them into layers in the following manner:

The plates are all put into a box, which, instead of having a bottom, is divided in the middle by a wooden grate. The plates disposed on this grate are so strongly heated by a chafing dish placed under them, that the woman employed in this labour is sometimes obliged to take them up with a cloth, in order that she may not burn her hands. As soon as they have acquired that heat, they are put into the jars in layers with the husks. Each jar is then closed with a covering of straw, and left to oxydate. This period is called *coüa*, to hatch. Thirty or forty pounds of copper, more or less according to the thickness of the plates, are put into each jar. At the end of ten, twelve, fifteen, or twenty days, the jar is opened; and if the husks are white, it is time to take out the plates. The crystals are then seen detached, and of a silky appearance on their surface. The husks are thrown back, and the plates are put in what is called *relai*. For that purpose they are immediately deposited in a corner of the cellar on sticks ranged on the floor. They are placed in an upright position, one leaning against the other; and at the end of two or three days they are moistened, by taking them up in handfulls and immersing them in water in earthen pans. They are deposited quite wet in their former position, and left there for seven or eight days; after which they are once or twice immersed again. This immersion and drying are renewed six or eight times, every seven or eight days. As the plates formerly were put into wine, these immersions were called *one wine, two wines, three wines*, according to the number of times. By this process the plates swell up, the green is nourished, and a coat of verdigrise is formed on all their surfaces, which may be easily detached by scraping them with a knife.

Each jar furnishes five or six pounds of verdigrise at each operation. It is then called fresh verdigrise, moist verdigrise, &c. This verdigrise is sold in that state by the manufacturers to people who dry it for foreign exportation. In this first state it is only a paste, which is carefully pounded in large wooden troughs, and then put into bags of white leather, a foot in height and ten inches in diameter. These bags are exposed to the air or the sun, and are left in that state till the verdigrise has acquired the proper degree of dryness. By this operation it decreases about fifty per cent, more or less according to its primitive state. It is said to stand proof by the knife, when the point of that instrument pushed against a cake of verdigrise through the skin cannot penetrate it.

The plates of copper which have been already used are again employed for the same operation, till they are almost completely consumed. Instead of heating them artificially, as above mentioned, they are sometimes exposed only to the sun. The same plates will serve sometimes for ten years, but they are often worn out in two or three. This, however, depends on the quality of the copper. That which is extremely smooth, well beat, and very compact, is always most esteemed.

Formerly moist verdigrise could not be sold till its quality had been previously ascertained; and for that purpose it was carried to a public warehouse, where it was sold after that point had been determined.

By comparing this process with that described by Montet, it will be found that the changes introduced are much in favour of the new. Formerly the workmen took the stalks of the grapes dried in the sun, and began by immersing them for eight days in *vinasse* (the residuum of the distillation of wine for making brandy). They then suffered the moisture to drain off through a basket, after which they put about four pounds into a jar, and poured over them three or four pints of wine. The stalks were made to imbibe a large portion of the wine, by stirring them strongly with the hand; the jar was then covered, and the stalks were suffered to ferment. The fermentation commenced sooner or later, according to the nature of the wine and the temperature of the air. But after it had once begun, the wine became turbid, and exhaled a strong odour of vinegar. At length the heat decreased, and the stalks were then taken out, and the wine was drawn off. When the stalks were a little drained, they were disposed in layers with the plates of copper, and the operation was continued in the same manner as with the husks. When the plates were taken from the jars to be put in *relai*, instead of immersing them in pure water, as is done at present, they were moistened three or four times with sour wine, which was called giving them three or four wines.

It may be easily seen that there is a great saving in the process followed at present, since the manufacturers no longer use wine, which enhanced the price of the verdigrise. Some have condemned, in the new process, the practice of using the copper too soon; but this objection fell to the ground, when it was observed that the verdigrise obtained was in proportion to the copper corroded; and what proves that this method is more advantageous, is, that all the manufacturers have abandoned the old method and adopted the new.*

No. 28.

On the Method of preparing Tallow Candles with Wooden Wicks. By Professor Medicus *of Heidelberg.*†

"FOR several years past tallow candles with wooden wicks have been prepared, in large quantities, by the candlemakers at Munich, and much used in that neighbourhood. I have burnt them during the whole winter, and never wish to use any other kind, as they are attended with several advantages which common tallow candles do not possess. They afford about the same quantity of light as a wax candle; burn also with great steadiness and uniformity, and never crackle or run. The candlemakers here keep the method of preparing these candles as secret as they can; but I shall communicate to the public what I have been able to learn respecting the process.

"The only difference between these candles and the common tallow candles is, that the ground work of the wick consists of a very thin slip of wood, bound round to a considerable thickness with very fine unspun cotton; but in such a manner that the size of the wick does not much exceed that of the wick of a common candle. The cotton is wound round the wick by the hand; but in general it is done by means of a reel, which I have not yet been able to see. The thin slips of wood are furnished to the candlemakers by the country people, and, if we may judge from their appearance, are cut into the proper form by means of a knife, without the application of any machine. They are for the most part somewhat square, and not completely rounded. The candlemakers often prepare these slips of wood also themselves, when they have none ready by them, and for that purpose use pine, willow, and other kinds of wood, though they commonly employ fir. For making these candles it is necessary to have the purest tallow: a pound will be sufficient to make six or seven, which cost twenty-five kreutzers. The price of common moulded candles with cotton wicks is twenty-two kreutzers; but as the former burn much longer, they are on the whole cheaper."

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* There are no large manufactories of verdigrise at Montpellier; but each family makes a certain quantity, and the operations are in general performed by women.

† Tilloch, vol. 4, p. 79. From Riems *Neue Sammlung Oekonomischer Schriften*, part 12.

Another method of making the wicks is as follows: Take shoots of the pine tree a year old, scrape off the bark, and when they are become perfectly dry scrape them again all round till they are reduced to the size of a small straw. When the above wood cannot be procured, well dried common fir twigs of a year old, and of the same strength, may be prepared in the like manner. These rods are then to be rubbed over with wax or tallow, till they are covered with a thin coating of either of these substances; after which they must be rolled on a smooth table in very fine carded cotton, drawn out to about the length of the rod or candle-mould. Care however must be taken that by this rolling no inequalities may arise on the rod, and that the cotton may be every where of equal thickness, though at the upper part a little more of it may be applied. After this preparation the wick will have acquired the size of the barrel of a small quill; and the more accurately the size of the wick is proportioned to that of the candle mould, the candles will burn so much the better, clearer, and longer, as will soon be found by a little experience: these wicks are then to be placed very exactly in the middle of the mould, and retained in that position, and good tallow, fresh if possible, previously melted with a little water, must be poured round them; but even old and rancid tallow will not run, if the wicks be properly made.

These candles, besides burning longer than the common ones, have also this advantage, that they do not flare, and that they are less prejudicial to the eyes of those who are accustomed to read or write at night. It is, however, to be observed, that a pair of sharp scissors must be employed for snuffing them, and that in performing that operation care must be taken not to break or derange the wick.

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No. 29.

Account of the Method of making Stilton Cheese. By Mr. John Monk, *of Bears-combe, Devon.**

STILTON cheese is made in most of the villages round Melton Mowbray, but I found it impossible to get at the secret of making it from the dairy people; and, from the conversation I had with one of the first managers, I should suppose two cheeses were never made alike, as it depends upon soil, herbage, seasons, heat, cold, wet, dry, &c. &c. There is no doubt but those cheeses require a great deal of care and attention, owing, I should suppose, to their richness and thickness. They run from eight to sixteen or eighteen pounds, very seldom larger, and are sold at one shilling per pound. Most of the inns in the county retail them, the price thirteen and fourteen pence per pound. I was informed by the maker, that they were never better for the table than at a year old, but I believe they are seldom cut so soon. The *best* of the other sort of cheese made in the county is, in my opinion, better than the generality of the Stilton, as it is but seldom you meet with a real good one.

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* Repertory, vol. 1, p. 175. From the *General View of the Agriculture of the County of Leicester;* drawn up for the consideration of the Board of Agriculture.

In respect to the grand secret of making Stilton cheese, I should have left the county without acquiring the process, if it had not been for the politeness and attention of major Cheselden, of Somerly, who, upon my acquainting him with my disappointment, kindly undertook to procure it for me from one of his tenants, who was among the first for making it. The following is the receipt.

Take the night's cream, and put it to the morning's new milk, with the rennet; when the curd is come, it is not to be broken, as is done with other cheeses, but take it out with a soil-dish altogether, and place it in a sieve to drain gradually, and, as it drains, keep gradually pressing it till it becomes firm and dry; then place it in a wooden hoop; afterwards to be kept dry on boards, turned frequently, with cloth binders round it, which are to be tightened as occasion requires.

N. B. The dairy-maid must not be disheartened, if she does not succeed perfectly in her first attempt.

In the dairies which I visited, the cheeses, after being taken out of the wooden hoop, were bound tight round with a cloth, which cloth was changed every day, until the cheese became firm enough to support itself; after the cloth was taken off, they were rubbed every day all over, for two or three months, with a brush; and if the weather was damp or moist, twice a day; and, even before the cloth was taken off, the top and bottom were well rubbed every day.

No. 30.

List of American Patents.

(Continued from vol. 1, page 480.)

1805.

Increase Kimball, May 1, machine for cutting nails, brads, &c

Joseph Copes, May 2, improvement in the grist mill.

Horatio G. Spafford, May 3, a close fire place.

F. Lippart, May 3, machine for raising water from a running stream.

John Stickney, May 4, improvement in andirons.

Robert Crane, junior, May 4, iron wheel for transporting carriages.

Samuel Church, May 4, a felloe mill.

John Houston, May 4, a metallic hone.

Simeon Glover, May 4, a cross cramp for four-wheeled carriages.

Abraham Higham, May 4, a washing and scouring machine.

Daniel Atherton, May 4, improvement in the physiognotrace.

Joseph Platt, May 4, machine for raising and removing earth.

Allen Hill, May 6, a beaming machine.

Jacob Welsh, May 6, machine for removing earth, &c.

John Kunitz, May 7, bleeding with and breeding leaches.

Isaac Baker, May 8, machine for sawing shingles.

W. Smith, May 9, improvement in glazing and polishing linens, &c.

George Poyzer, May 10, improvement in making cod oil for leather.

M. Zorger, May 10, machine for shelling and hulling clover seed.

Ebenezer Lester, May 10, making moulds for casting iron screws.

Barn. Langdon, May 10, improvement in manufacturing tin ware.

James Humiston, junior, May 10, improvement in the sluice to convey water to horizontal wheels, and in the manner of forming the wheels of cast iron, &c.

H. Witner, May 17, improvement on Anderson's condensing tub.

Thomas W. Pryor, May 21, improvement in the bark mill.

William Hodgson, May 22, apparatus for making tiles, bricks, &c.

Thomas Pierce, May 24, improvement in the smut fanning mill.

William Cobley, May 27, mode of making posts of clay for fencing.

Daniel Tomlinson, May 27, machine for raising or projecting fluids.

Benjamin Eggleston, junior, May 27, method of boiling, applicable to distilling, brewing, &c.

Ebenezer Jenks, June 1, improvement in the mode of setting boilers of every description.

John Bennock, June 1, improvement in planing by machinery.

J. Hinman, June 1, planing machine for sawing bellows boards, &c.

Alexander M'Nitt, June 15, method of separating, preparing, and collecting the sulphate of pot-ashes into sal polychrestum, &c.

Lewis Valcourt, June 25, improvement in mills and machinery.

J. Macbride, Aug. 8, machine for ginning, carding and spinning cotton.

J. Matthews, Aug. 13, machine for grinding, sawing, or rasping dye woods.

William Wing, Aug. 28, machine for casting types.

William Wing and Henry Salisbury, Aug. 29, improvement in springs for wheel carriages.

Ch. M'Lean and Sol. Loomis, Sept. 25, improvement in tub mills.

Samuel Bartlett, Oct. 1, a clay pipe for conduits.

Asahel A. Kelsey, Oct. 9, improvement in making shingles.

Daniel French, Oct. 9, manufacturing old junk or old rigging into oakum.

Joseph Share, Oct. 28, improvement in casting ship bolts.

William Deane, Nov. 4, improvement in rafts.

La Paype (ainé) Nov. 4, improvement in cattle mills.

Seraphim Bellij, Nov. 7, machine for raising water.

William Lillie, Nov. 9, machine for splitting skins.

John Gilman Taylor, Nov. 13, improvement in making salt.

Friend B. Kellogg, Nov. 22, machine for shearing woollen or other cloth by water, &c.

Abraham Heistand, Nov. 27, a distilling apparatus.

James Tatterson, Dec. 7. machine for preparing and hackling tow for paper or linen.

William Johnson Fulsom and John Hayden, Dec. 17, machine for washing, rinsing, and wringing clothes.

George Barber Dexter, Dec. 18, rheumatic pill.

William Poole, Dec. 20, a kiln for drying grain.

James Abraham, Dec. 20. improvement in kilns for drying grain.

Samuel Adams, Dec. 28, machine for reaping grain.

1806.

Ebenezer Bryant, Jan. 13, a rowing machine.

Sam. Goodwin and Rich. Gains, Jan. 22, a balance pendulum lock.

R. Gookins, Jan. 24, machine for making bats or frames for wool hats.

C. Thompson, Feb. 5, machine for copying charts, landscapes, &c.

Philip Bennet, Feb. 8, a loom for weaving chip.

William Finn, Feb. 15, a spring pump for raising water.

Michael Morrison, Feb. 14, machine for picking oakum.

George Richards, Feb. 14, machine for making dough.

Theodore Burr, Feb. 14, improvement in bridges.

Joseph Hawkins, Feb. 19, a planing machine.

Samuel Hawkins, Feb. 19, improvement in gun carriages.

John Eveleth, Feb. 21, machine for raising mud.

Israel Newton, Feb. 28, medicine called the essence of tansy.

John F. Gould, March 1, machine for making bricks.

Richard Howel, March 5, improvement in suspenders.

Thomas Arnold, March 5, improvement in evaporation.

Samuel Dickey, March 7, improvement in stoves.

John F. Gould, March 8, improvement in tilt hammers.

Joseph S. Mott, March 8, a joining and planing machine.

Richard Gaines, March 17, a balance pendulum lock.

William Purden, March 19, a hoisting machine.

George Youle, March 21, improvement in a cabouse.

Elisha Mack, March 21, machine for dressing flax.

Daniel Pettibone, March 22, preparing and welding cast steel to iron or other steel for tools.

John Kennion, March 26, a fulling mill and washing machine.

Abner Guild, March 31, carding machine to form batts for wool hats.

S. Payn, March 31, machine for splitting skins or neats' leather.

Richard Tripe, April 1, improvement in diving machines.

Isaac Quintard, April 5, improvement in cyder and bark mills.

John Heavin, April 17, improvement in propelling boats.

Do. Do. machine for cutting straw.

Joseph Quinby, April 25, improvement in saw mills.

Ephraim Hubbel, May 1, improvement in water wheels for mills.

C. Varlé, May 2, method of reducing calcareous matters into lime.

John Edwards, May 19, improvement in the steelyard.

John Edwards, May 19, improvement in scale beams and balances.

George Youle, May 21, a cabouse stove, apparatus for cooking and distilling, &c.

John Cooper, May 22, improvement in windmills.

James Gridley, May 23, improvement in boxes for carriage wheels.

Beriah Swift, May 25, machine for shearing cloth.

Abner Wing, May 26, improvement in the churn.

Reuben Buck, May 29, a washing machine.

Levi Brown, May 30, improvement in boxes for carriage wheels.

Standfast Smith, June 12, method of extracting salt from sea water.

Standfast Smith, June 13, improvement facilitating the process of extracting salt from sea water.

Solomon M'Combs, Joseph, Smith, and Benjamin D. Galpin, June 24, improvement in filtering impure water, wine, &c.

William Harwood, July 3, improvement in making pantiles.

Roger Selden, July 7, a perpendicular boring machine.

N. Cutting, July 14, machine for facilitating the spinning of rope yarn, &c.

John Bedford, July 16, improvement in making boots and shoes.

Zachariah Mills, July 17, a swing cradle.

William Wadsworth, July 17, anti-stream boat.

T. Woodsend, Aug. 7, a cover for buildings called artificial slate or tile.

N. Cutting, Aug. 14, apparatus for improving the quality of cables, &c.

Alexis Carrendeffez, Sept. 2, improvement whereby a beautiful yellow paint may be prepared.

J. T. Morgan, Oct. 9, machine for raising vessels out of water to repair them.

George B. Dexter, Oct. 9, apparatus for the sublimation of sulphur.

James Pountrey Wightman, Oct. 21, mixture to render all kinds of woollen cloth water proof.

William Tullock, Oct. 28, improvement in screens for freeing grain from dirt, seeds, &c.

Jonas Dawson, Nov. 6, improvement in suspenders.

James Deneale, Dec. 4, a perpetual oven.

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Louis De Niroth, Feb. 3, composition for covering and flooring houses.

Levi Rogers, Feb. 4, a Traverse sleigh.

David Brown, junior, Feb. 5, machine for winding cotton.

John Matthews, Feb. 6, machine for grinding, sawing, and rasping dye woods.

Parke Shee, Feb. 7, a paper trimmer.

John Beath, Feb. 7, accommodating bolted truss for ruptures.

William Hale, Feb. 7, improvement in the augur.

Jonathan Ellis, Feb. 10, machine for cutting brads.

Samuel Millikin, Feb. 10, mode of making the bottoms of shoes and boots of metallic substances.

Abel W. Hardenbrook, Feb. 10, a water tight swivel screw, adapted to steam engines, stills, &c.

W. Montgomery, Feb. 11, improvement in making boots and shoes.

Abraham Ogier Stansbury, Feb. 11, the Egyptian lock.

Charles Fales, Feb. 11, method of making charcoal from peats.

Richard Button, Feb. 11, a hemp and flax machine.

Ebenezer Lester, Feb. 12, method of making moulds for casting trundle heads, of any kind of metal, &c.

Abraham Hobart, Feb. 17, a tilting waggon.

Abraham Fisher, Feb. 19, a fire place with a flat funnel.

A. Buffum, Feb. 21, machine for carding fur and wool, for hats.

Ezekial Hale, Feb. 22, improvement in the grist mill.

Jesse Reed, Feb. 22, machine for cutting and heading nails at one operation.

Joel Fox, junior, Feb. 25, machine for working a trip hammer with a perpendicular handle.

Gersham and Barnt G. Burtis, improvement in making butter.

Richard R. Elliot, Feb. 28, a washing machine.

Timothy Green, April 1, mode of making salt.

Lewis Dupré, April 1, a pendulum screen.

Charles Colver, April 1, a double forcing pump.

G. Youle, April 1, improvement in the cabouse stove for cooking, &c.

David Peacock, April 1, improvement in ploughs.

Jeremiah M‘Ilvain, April 1, machine for dressing shingles and staves.

Elisha Bigelow, April 1, machine for cutting nails.

J. A. Pearce, April 7, machine for propelling boats, &c. by oars.

A. Craig, April 15, machine for raising stumps, &c. from the ground.

Sylvester G. Whipple, April 17, improvement in the application of bark for hats, caps, &c.

Ebenezer Jenks, April 17, improvement in making fire brick.

Jonathan Mix, April 18, improvement in main springs for carriages.

Thomas Pope, April 18, improvement in the construction of bridges.

Barnabas Langdon, April 23, improvement in the steelyard.

Abraham Weaver, April 23, improvement in an apparatus for, and mode of distilling.

Henry Dunlap, April 23, improvement in the splinter bar and swingle trees of carriages, so as to disengage the horses from them suddenly.

A. Pollock, April 23, improvement applicable to fire places and stoves.

Allan Pollock, April 24, improvement in heating rooms, &c.

Simon Willard, junior, April 25, a washing machine.

T. Beatty, April 25, a washing, scouring, and churning machine.

John Sellers and Andrew Bartle, May 5, method of making ropes and lines of any size.

Charles Hammond, May 6, a gunner's quadrant.

Cornelius Tobey, May 7, machine for breaking and grinding bark.

Charles Kinsey, May 8, machine for making paper.

Russel Dorr, May 8, machine for shearing cloth.

Stephen Sayre, May 9, improvement in rigging vessels of every denomination.

Peter Harvey, May 9, improvement in hanging curtains or blinds in coaches, &c.

Thomas Young, May 11, improvement in shingling the roofs of houses, &c.

William Young, May 20, improvement in lasts for boots and shoes.

Jacob Smith, junior, May 20, improvement in the fire engine.

John Green, May 20, mechanical spring buckle.

Christian Hamaker, May 21, improvement in mills.

Josiah Cleaveland, June 6, a washing machine.

Simeon Glover and David Parmelee, June 8, a mortising machine.

W. Phoebus, June 9, improvement in galvanism for salivating, &c.

Stephen Steward, June 20, improvement in stills.

Obadiah Crawford, June 22, improvement in cotton gins.

Enoch Burt, June 23, improvement in machines for shearing cloth.

Jacob Spofford, June 23, improvement in saw mills.

Reuben Buck, June 23, improvement in churns.

Cyrenus Beach, June 26, improvement in the axle and box of carriages.

Michael Freytag, July 1, improvement in the filtering pot.

Ralph Shaw, July 2, improvement in piano fortes, &c.

Jordan Dodge, July 8, method of manufacturing wrought nails and brads.

T. O'Connor, July 9, improvement in condensers in distillation.

Webster Lewis, July 10, machine for making pills.

Jonathan Nichols, July 11, machine for making wrought nails.

Matthew Longwell, July 11, mode of heating water in boilers of steam engines, by the rays of the sun.

John B. Sartori, July 13, improvement in making Italian pastes, maccaroni, vermicelli, &c.

Josiah Cleaveland, July 18, machine for cutting straw.

Benjamin Connor, July 20, machine for cutting straw.

Ebenezer Jones, July 24, a washing machine.

Thomas Bruff, July 24, apparatus for, and mode of cleaning windows.

Joseph Lehman, Aug. 11, in preparing a vermifuge.

Martin Lee and Timothy Barber, Oct. 1, improvement in washing machines.

Buel Cutler, Oct. 3, a churning machine.

Edward Richardson, Oct. 3, improvement in stills.

Thomas M'Ilwham, Oct. 6, moulds for casting copper sheathing nails, &c.

Alexis De Carrendeffez, Oct. 12, improvement in preparing green colouring matter or paint.

Orange Webb, Oct. 14, mode of preparing leather for straps, suspenders, &c.

Joseph Pitkin and Timothy Kimball, Oct. 19, machine for planking hats and making cloth without yarn.

Jesse Arnold, Oct. 26, improvement in the cheese-press.

Richard Wheatly and James Beaumont, Nov. 4, method of manufacturing sheet iron into funnel for stove pipes, &c.

James Butland, Nov. 12, improvement in manufacturing iron.

Seth Vinton, Nov. 18, a plough harrow.

Isaiah Jennings, Nov. 20, method of manufacturing thimbles for the sails of ships, &c.

Anson Blake, Nov. 27, a guage setting machine for saw mills.

Benj. B. Bernard, Nov. 30, improvement in thrashing machines.

Simon Willard, Nov. 30, machine for cutting and heading nails.

S. Willard, jr. Nov. 30, machine for thrashing and cleaning grain.

Simon Willard, junior, Dec. 1, improvement in the water wheel.

William Thornton, Dec. 13, an improved still.

Samuel Rogers, Dec. 15, machine for heading nails.

John Scripture, Dec. 15, a churning machine.

Jerem. H. Pierson, method of manufacturing hoop and sheet iron.

Isaac Pierson, Dec. 24, improvement in rolling and slitting mills.

(To be continued.)

THE

EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 2.] JANUARY, 1813. [NO. 9.

NO. 31.

Memoir upon the Vineyards and Wines of Champagne in France: Written in answer to certain Queries circulated by M. CHAPTAL. *By M.* GERMON, *of Epernay.*

(Concluded from page 91.)

Is Grafting attended with Advantage?

FIFTY years ago they used to graft the vines on the mountains, and they generally obtained very fine vines with large fruit. This plan has now been abandoned, because it has been discovered that a grafted vine does not last so long as an ungrafted one, and the grafted vine is always more tender and delicate; besides, it produces a poorer kind of wine.

How many Dressings are given to the Vines previous to the Vintage?

The first dressing, which is called *becherie,* (hoeing,) is given immediately after the frosts have disappeared.

In general, as soon as the bud of the vine makes its appearance the women proceed to prune, and the men follow with the first dressing. This is a pernicious system; but the prejudices of the proprietors have not yet given way to the counsels of men of science.

The vines are pruned at the same time with the first hoeing; but this method is not practised in the Marne district, where they prune subsequently to the hoeing: it frequently, however, saves the prunings from the effects of the frost, and presents a resource to the proprietor if the vines have suffered from this accident.

Two other dressings are afterwards given, one in June and the other in August; but some proprietors, who are jealous of the good qualities of their vines, give them a third dressing in September.

What are the Processes employed in gathering and pressing the Produce of the Vintage?

In order to make red wine,—when the fruit is perfectly ripe, the black grapes only are carefully picked and gathered. The white grapes are laid aside, as well as those red ones which are not ripe; and these are afterwards made into wine of an inferior quality. The ripe red fruit, when thus separated, is put into panniers, or small wooden boxes called *barillets* or *cuvelets*, and conveyed on the backs of beasts of burden to the pressing place: here they are pressed by small portions at a time, and the juice then put into a tub to ferment. In performing this operation some proprietors employ an utensil called a martyr, which is very useful. This is an oblong coffer, less than the diameter of the fermenting tub, and about a foot or eighteen inches high. This coffer rests upon beams placed across the fermenting-tub, and its bottom and sides are pierced with holes in such a manner as to allow the expressed juice of the grapes to flow through into the tub.

How long is the Wine allowed to ferment?

It would be difficult to fix any precise time for the duration of the fermentation; this depends entirely upon the nature and maturity of the fruit, and upon the influence of the atmospheric air. Grapes gathered in the morning will more slowly go into fermentation than those which have been gathered after noon-day in fine weather:—mists, rains, and hoar-frosts, all retard fermentation more or less.

In some years, three or four days are sufficient for producing a fermentation sufficient for preparing the fruit for the press:—in other years, ten, fifteen, and even twenty days are required.

By what Sign is it ascertained that the Fruit has attained a proper Degree of Fermentation?

We cannot assign any certain symptoms that the wine has sufficiently fermented, as the period proper for placing the bruised fruit into the presses depends upon various causes; upon the pleasure and experience of the proprietor, and upon the quality and colour which he wishes to give to his wine. Some place the fruit in the press at the strongest degree of fermentation, and others when it has slackened.

After the fermentation begins, in order to hasten it, they squeeze down the fruit in such a manner as to keep the must always uppermost: poles armed with spikes are used for this purpose; or, what is better, some strong workmen descend into the vat and tread down the fruit: the fermentation thus becomes more equal and more general; and when it has proceeded far enough, the must is carried to the press and the wine is made.

In ordinary years, when a lighted candle cannot be held over the tub without going out; when the grapes and husks ascend to the top, notwithstanding their being repeatedly pressed down; when the must undergoes a kind of ebullition; and lastly, when the colouring particles are sufficiently decomposed to satisfy the wishes of the proprietor,—it would be dangerous to push the fermentation any further, as in that case the wine might assume a dry and hard taste which even time could not correct, particularly in Champagne wines, which are prized on account of their pleasantness and lightness. The most consummate experience is sometimes unsuccessful in the above operations, and there has been no instrument yet invented which can be depended upon.

Is it advantageous to mix the extractive Liquor of the Tubs with that which is produced by pressing?

This may be answered in the affirmative, with respect to the whole of Champagne;— and it is very advantageous for the following reasons:

1st, The wine made from the tub would be paler in colour and more delicate than that which is expressed from the husks.

2dly, The wine which came from the press only, would be harder, stronger, and redder, than the other; so that from the same tub we should certainly have two different kinds of wine:—The mixing of them is therefore indicated by experience, and it is at all times necessary to have wines of an equal quality.

Is it advantageous to bruise the Stones of the Grapes?

This operation depends upon the season, and upon the ripeness and nature of the fruit. When the fruit is small and the stone large, or when the fruit has not acquired all its maturity, the stones should be bruised.

When the fruit is full and well grown, when the season has been rather dry than humid, this operation may be omitted. It has been ascertained, however, that the strong and rough taste of the stones is necessary, as one of the constituent parts of wine.

To what Accidents are Red Wines liable when in the Casks?

The accidents to which red wines are liable, are yellowness, muddiness, and a wormwood taste. These accidents happen when the wines are kept in badly aired cellars, or when the fruit has been damaged during the vintage season by frosts or continual rains.

How are the Red Wines managed?

When the red wine which comes out of the tub, and that which has been expressed from the husks, are well mixed together in a vat procured for the purpose, the whole is poured into new puncheons previously rinsed with hot water; but they are not filled at once, because the wine always ferments for a few days longer: as the fermentation ceases they are filled and bunged up, leaving a small spiggot in the bung in order to allow the gas to pass out: when the fermentation has entirely ceased the puncheon is hermetically closed.

About the end of December, and if possible in dry weather, the wine is drawn off and freed from the greatest part of the lees.

About the middle of May, before the warm season commences, the wine is again drawn off clear. Before putting the puncheons into the cellar they are furnished with new hoops, where they are kept during the summer, or till they are sold, otherwise their contents would be spoiled.

What is the Method of clarifying Red Wines?

This consists in drawing off the wine a third time.

The whites of five or six fresh eggs are diluted in a chopin of water; and this quantity is sufficient for each piece or puncheon containing two hundred and forty bottles.

There are only two hundred bottles in a puncheon of white wine.

The whites of eggs are well beaten up and then thrown into the puncheon, the contents of which are then briskly stirred up by a cleft stick.

This operation is performed previous to bottling the wine or sending it off to a market.

At what Age should Red Wines be bottled?

In general, the red wines of *Haute Montagne* are bottled in the month of November succeeding the vintage, that is, thirteen months afterwards. This season of the year is fixed upon because all germination has ceased, and Nature is in a state of perfect repose; thereby all fermentation is avoided; and red wines may therefore be safely bottled from the first of October until the end of December: at any other season great inconveniencies would arise; for I know of nothing worse than red wine bottled in spring time; it retains a slight degree of fermentation, and is very disagreeable to the taste.

There are some excellent and generous wines which can remain three or four years on their lees: of this description are the wines of Saint Thierry.

How long will Red Wines keep in Bottles?

The more body and spirit the wine has, the better is it preserved in bottles: the more tender, delicate, and light it is, the more difficultly is it kept.

This is the reason why the wines of Mailly, Chiny, Chenay, and Hermonville, keep worse than those of Verzenay, Bouzy, and Verzy; and these last worse than those of Saint Thierry. To conclude:—We may safely venture to say, that the best red wines of Haute Montagne will keep in good cellars for six, eight, ten, and twelve years.

What Degree of Temperature, according to Reaumur's Thermometer, ought the Cellars to have?

The cellars in Champagne are from twenty-five to forty feet in depth, particularly those which are dug in beds of chalk, and in which it is necessary to dig low, in order to obtain such a solidity of earth above, as to render an arch unnecessary. It results from experiments made by Messrs. Dubois, merchants at Rheims, that several good thermometers placed in various situations in their cellars, always marked five degrees below the temperature of the atmosphere. The variations between winter and summer were not half a degree, and could not be noted.

What is the Cost of an Acre of Vineyard?

FIRST CLASS.

	Livres.
In Haute Montagne . .	2000
In Basse Montagne . .	1000
In Saint Thierry . .	900

SECOND CLASS.

	Livres.
In Haute Montagne . .	900
In Basse Montagne . .	600
In Saint Thierry . .	300

The convent lands, and what is called Clos Saint Thierry, are not taken into this computation.

What is the annual Expense of Cultivating an Acre of Vineyard, including the Expense of Vintage and of Pruning?

	Livres.
To the vine dresser . . .	50
Props	18
Mending them, and carriage, &c.	40
Prunings and contributions . .	24
Four puncheons	40
Expense of vintage . . .	28
	200

GENERAL OBSERVATIONS.

WE have only mentioned the culture of vines in general, without detailing those of the high and low grounds separately. There are many vineyards, however, and particularly in Saint Thierry, where the greater part of the vines is always raised to the height of about five feet, and supported by props of oak, six feet high, and an inch in diameter. This kind of vine can only answer in strong and vigorous ground.

The difference between the culture of the high and low vineyards, consists in the shaping, tyeing, and pruning.

1st, Shaping consists in choosing from the sucker the best stalk, in preference to others which are cut off, and all the small collateral shoots are lopped off.

2dly, The tyeing is effected when the sap is most abundant, and the bud already developed: the above single stalk is bent like a hoop, and tied to the prop in two or three places.

3dly, Pruning consists in reinserting into the earth, and into small and long holes, every ten or fifteen years, the old sucker, upon which three or four stalks are left, which are also buried in the earth; and they send out an excellent plant for the ensuing year. This operation is called *ravallement*, and is very different from the pruning practised in the department of the Marne.

An intelligent proprietor, who has a large extent of vineyard, should bury some vines (*ravaller*) every year, in order to have a sure and constant supply of plants for replanting.

The methods of treatment are in every respect the same with high and low plants.

No. 32.

*Account of the Process employed in making Cheshire Cheese.**

Preparation of the Rennet.

WHEN the maw skin comes from the butcher, the chyly matter is taken out, and the skin cleaned from slime and every apparent impurity, by wiping or gently washing. The skin is then filled nearly full of salt, and, placing a layer of salt upon the bottom of a mug, the skin is laid flat upon it: this mug is large enough to hold three skins in a course: each course of skins should be covered with salt; and when a sufficient number of skins are thus placed in the mug, that mug should be filled up with salt, and, with a dish or slate over it, be put in a cool place, till the approach of the cheese making season the following year. The skins are then all taken out and laid for the brine to drain from them; and being spread upon a table, they are powdered on each side with fine salt, and rolled smooth with a paste roller, which presses in the salt. After that, a thin splint of wood is stuck across each of them to keep them extended while they are hung to dry. Take all the maw skins provided for the season, pickled and dried as before; put them into an open vessel or vessels, and for each skin pour in three pints of pure spring water. Let them stand twenty-four hours, then take out the skins, put them into other vessels; add for each one pint of spring water, let them stand for twenty-four hours as before. On taking the skins out the second time, gently stroke them down with the hand into the infusion. The skins are then done with. Mix those two infusions together, pass the liquor through a fine linen sieve, and add to the whole a quantity of salt, rather more than is sufficient to saturate the water; that is to say, until a portion of the salt remains undissolved at the bottom of the vessel. The next day, and also the summer through, the scum as it rises is to be clearly taken off; and as the liquor should not be suffered to remain without a portion of undissolved salt at the bottom, it will be necessary to add frequently fresh salt, as that which was dissolved will gradually form itself into crystals, and be taken off with the rising scum. Somewhat less than a wine half pint of this preparation will be generally sufficient for sixty pounds of cheese. Whenever any of this liquid is taken out for use, the whole should be well stirred up.

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* Tilloch, vol. 11, p. 230. From the *Agricultural Report of Cheshire County.*

Colouring for the Cheshire Cheese.

The colouring for cheese is, or at least should be, Spanish annotta; but as soon as colouring became general in this country, a colour of an adulterated kind was exposed for sale in almost every shop: the weight of a guinea and a half of real Spanish annotta is sufficient for a cheese of sixty pounds weight. If a considerable part of the cream of the night's milk be taken for butter, more colouring will be requisite. The leaner the cheese is, the more colouring it requires. The manner of using annotta is, to tie up in a linen rag the quantity deemed sufficient, and put it into half a pint of warm water over night. This infusion is put into the tub of milk in the morning with the rennet infusion; dipping the rag into the milk, and rubbing it against the palm of the hand as long as any colour comes out.

Setting the Cheese together.

It is, we believe, generally admitted, that not only the quantity, but the quality of the curd, as to texture, namely, toughness or otherwise, depends in a great measure upon the length of time the cheese is in coming; and that the time, again, depends on the quantity and strength of the coagulum used, the state of the atmosphere, and the heat of the milk when put together. In this stage of the art, where a degree of accurate certainty seems to be required, there is no other guide but the hand and the external feelings: the thermometer of a Cheshire dairy-woman is constantly at her fingers' ends: accordingly the heat of the milk when set, is endeavoured to be regulated by the supposed warmth of the room and the heat of the external air; having reference also to the quantity and strength of the steep, so that the milk may be the proper length of time in sufficiently coagulating, which is generally thought to be about an hour and a half. The evening's milk of suppose twenty cows having stood all the night in the cooler and brass pans, the cheesemaker in summer, about six o'clock in the morning, carefully skims the cream from the whole of it, observing first to take off all the froth and bubbles, which may amount to about a pint; this, not being thought proper to be put into the cheese, goes to the cream mug to be churned for butter; and the rest of the cream is put into a brass pan

While the dairy-woman is thus employed, the servants are milking the cows, having previously lighted a fire under the furnace, which is half full of water. As soon as the night's milk is skimmed, it is all carried to the cheese-tub, except about three fourths of a brass pan full, viz. three or four gallons, which is immediately placed in the furnace of hot water in the pan, and is made scalding hot; then half of the milk thus heated in the pan is poured also into the cheese-tub, and the other half is poured to the cream, which, as before observed, is skimmed into another brass pan. By this means all the cream is liquified and dissolved so as apparently to form one homogeneous or uniform fluid, and in that state it is poured into the cheese-tub; but before this is done several bowls or vessels full of new milk will generally have been poured into the cheese-tub, or perhaps the whole morning's milk. Care is taken to skim off all the air bubbles which may have formed in pouring the new milk into the cheese-tub.

The rennet and colouring being put into the tub, the whole is well stirred together, a wooden cover is put over the tub, and over that is thrown a clean linen cloth. The usual time of coming is an hour and a half, during which time it is to be frequently examined: if the cream rises to the surface before the coming takes place, as it often does, the whole must be stirred together, so as to mix again the milk and cream, and this as often as it rises, until the coagulation commences. A few smart strokes on different sides of the tub with the cheese-ladder, &c. will forward the coagulation, if it is found too long in forming. If the dairy-woman supposes the milk, &c. to be accidentally put together cooler than she intended, or that its coolness is the cause of its not coming, hot water or hot milk may be poured into it, or hot water in a brass pan may be partially immerged therein; but this must be done before it is at all coagulated; for, after that takes place, though but imperfectly, it must not be tampered with so as to break the forming curd, for a considerable part of the cream would thereby be directed into the whey, and the quantity of curd much lessened. Before the coagulation takes place, an additional quantity of rennet may also be put in, if thought necessary; but this will, after coagulation, be added with little effect, as no means can be used to mix it with the whole mass without disturbing the forming curd. If the cheese has been set together hotter than it was meant to be, the opposite means, under the same precautions, may be recurred to. But the more general practice is, to suffer the process to proceed hot as it is, until the first quantity of whey is taken off; a part of which, being set to cool, is returned into the tub to cool the curd. When the cheese happens to come much sooner than a proper time, owing to too great a degree of heat in the milk in setting or putting together, or too great a strength of steep, there is less curd, and it is considerably tougher than when the milk has been set cooler together than usual, or when too little steep has been used. In the latter case, the curd is exceedingly tender: and, when that so happens, a part of the whey is taken out of the cheese-tub, and heated as much as may be thought sufficient to give to the curd, when mixed with it, a proper degree of toughness. In an hour and a half, as mentioned before, if all goes on well, the coagulation will be formed. This point is determined by gently pressing the surface of the milk with the back of the hand.

Breaking down the Curd, Gathering, &c.

If the milk has been set together very warm, the curd, as before observed, will be firm: in this case, the usual mode is to take a common case knife, and make incisions across it to the full depth of the knife's blade, at the distance of about one inch; and again crossways in the same manner, the incisions intersecting each other at right angles. The whey rising through these incisions is of a fine pale green colour. The cheese-maker and two assistants then proceed to break the curd; this is performed by their repeatedly putting their hands down into the tub, the cheese-maker with the skimming dish in one hand breaking every part of it as they catch it, raising the curd from the bottom, and still breaking it. This part of the business is continued till the whole is broken uniformly small: it generally takes up about forty minutes, and the curd is then left covered over with a cloth for about half an hour to subside. If the milk has been set cool together, the curd, as before mentioned, will be much more tender, the whey will not be so green, but rather of a milky appearance. The cheesemaker in this case, instead of the knife, has recourse to the skimming dish, the edge of which she holds perpendicular to the surface of the whey in the tub, and dips it gently an inch or two into the curd, turning it over, until the whole surface is thus turned. The breaking then proceeds as before; but a cautious and gentle mode of doing it is more necessary than in the former case. Rather more time, of course, is necessary for breaking down a cold than a hot cheese; but when sufficiently broken, it is covered over, and left to subside as before. After standing about half an hour, as much whey is taken out of the tub into the brass pans as conveniently may be, without taking any of the curd with it. The bottom of the tub is now set rather a-tilt, the curd is collected to the upper side of it, a board is introduced of a semicircular form to fit loosely one half of the tub's bottom. This board is placed on the curd, and a sixty pound weight upon it, to press out the whey, which draining to the lower side of the tilted tub, is laded out into brass pans. Such parts of the curd as are pressed from under the board, are cut off with a knife, placed under the weighted board, and again pressed. This is repeated again and again, the whey being constantly laded out as it drains from the curd. The whole mass of curd is then turned upside down, put on the other side of the tub, again pressed, pared, and pressed as before.

The board and weight being removed, the curd is cut into several pieces of about eight or nine inches square, piled upon each other, and pressed with the board and weight, repeating the cutting and piling, as long as any whey drains from it. It scarcely need be added, that the more gently the whole of the business in the tub is performed, the more perfect will be the separation of curd and whey.

The next thing is to break the curd in a brass pan. After being pressed in the tub as long as any considerable quantity of whey drains from it, the curd is cut into nearly three equal portions; one of which is taken into a brass pan, and is there, by two women, broken exceedingly fine. As soon as it is coarsely broken, a large handful of salt is added, which in the subsequent breaking is well mixed with the curd; that portion of curd, being sufficiently broken, is put into a cheese vat, which is placed to receive it on a cheese-ladder over the cheese-tub: the vat is generally furnished with a coarse cheese-cloth. The second and third portions of the curd are treated in the same manner, and emptied into the vat; sometimes five or six times the quantity of salt is added to the middle portion of the curd; others, salt all alike. The breaking takes up more or less time as the cheese was set together hotter or colder; half an hour is perhaps the longest time.

Thrusting or Hand-pressing the Cheese into the Vat.

THE curd, when put into the cheese-vat in its broken state, is heaped above the vat in a conical form, to prevent it from crumbling down; the four corners of the cheese-cloth are turned over it, and three women, placing their hands against the conical part, gently but forcibly press it in nearly a horizontal direction, constantly shifting their hands when any portion of the curd is starting from the mass, and turning down and folding up the cloth as occasion requires. As soon as the curd adheres together so as to admit it, a small square board, with a corner of the cloth under it, is put on the top of the conical part of the curd, with a sixty pound weight upon the board. Several iron skewers are at this time stuck in the cone, and also through holes in the sides of the vat. Several use a wooden lever to press down the cheese.

The employment of the women is now drawing out and putting in the skewers; thrusting and keeping together the portions of the curd, that the power of the weight or lever displaces. This operation is continued until the whey, which at first ran from it freely, begins to be discharged by drops; the weight and skewers are then removed and one woman takes up the corners of the cloth, while the others break the curd half way to the bottom of the vat, as small as they can.

Some people use a wooden or tin hoop, nine inches broad, instead of holding up the corners of the cloth during this breaking. After the upper half of the cheese is thus broken, a weight or other power is again applied to it, and is skewered and thrusted as before: at first the whey again runs freely, and the operation is continued as long as those means will press out a drop of whey. Two of the women then take the four corners of the cloth, the skewers, &c. being removed; and the other woman lays hold of the vat which is drawn from the cheese; and after rinsing it in warm whey, and putting another clean cloth over the upper part of the cheese, it is returned inverted into the vat again, and, being placed on the ladder over the tub, is broken half way through, as before; thrusting, weighting, and skewering, &c. is repeated, and continued from two to four hours, or as long as a drop of whey can be extracted from the cheese.

Putting the Cheese into the Press.

WHEN no more whey can be extracted by the aforesaid means, the cheese is again turned into the vat and rinsed, as before, with warm whey. The cloth now made use of is larger and finer than the former, and is so laid on one side it shall be level with the side of the vat, and on the other wrap over the whole surface of the cheese, and the edges put within the vat; thus perfectly inclosing the whole cheese in the cloth. In this stage of the business, the cheese is still higher than the edge of the vat; and to preserve it in due form recourse is had to a tin binder or hoop, about three inches broad, which is put round the cheese on the outside of the cloth, and the lower edge of the binder pressed down within the vat, so low as that the upper edge of it may be level with the surface of the cheese. The cheese is then carried to the press; and a smooth strong board being placed over it, the press is gently let down upon it; the usual power of which press is about fourteen or fifteen hundred pounds weight.

As soon as the cheese is put into the press, it is well skewered; the skewers are of a strong iron wire, eighteen or twenty inches long, sharp at the points, and turned with a bow at the other end. The vat and tin binder have holes to receive the skewers, especially the binder, which holes are seldom more than one inch from each other. As the press stands close to a wall, only one side of the cheese can be skewered at a time; therefore as many skewers are stuck in different directions as conveniently may, leaving as many holes unskewered as are skewered, to give an opportunity of changing the holes. The business of skewering continues till the next morning at six o'clock, and in that time the oftener they are shifted the better; every second time of shifting them the cheese is turned half way round in the press, to come at the other side of it. In half an hour from the time the cheese is first put into the press, it is taken out again and turned in the vat into another clean cloth. At this time the edges of the cheese are pared off, if they have become sharp under the press; but as the vats are now usually made with the angles rounded, the paring is rendered unnecessary, the vat being wiped dry before the cheese is returned to it.

When the cheese is thus the first time taken out of the press, it is the custom of some places to put it into warm, and in others into hot whey, where it stands an hour or more. It is then taken out, wiped dry, and after it has stood till cool, it is returned back to the press. This is done with a view to hardening its coat, that it may stand the better. At six o'clock in the evening the cheese is again turned in the vat into another clean cloth. At this and the former turning, some dairy women prick the upper surface of the cheese all over, an inch or two deep, before it is replaced under the press, with a view of preventing blisters. At six o'clock in the morning it is again turned in the vat, with a clean cloth as before. The skewers are now laid aside. When the next day's cheese is ready for the press, the former one is again turned in the vat with a clean cloth, and put under another press. At six o'clock in the evening, and at six the morning following, it is again turned in the vat, using at these two last turnings two cloths finer than those before used, in order that as little impression as possible from the cloth may remain on the coat of the cheese.

Salting the Cheese.

Four or five days after the cheese has been under the press, a fresh fine cloth is put under it, which serves only as a lining to the vat, and is not turned over the upper surface of the cheese, as has been hitherto the case. It is then taken and placed nearly midside deep in brine in a salting tub; the upper surface of the cheese being covered all over with salt. It stands generally about three days in the salting tub; is turned daily, and each turning well salted, the cloth being twice changed in the time. The cheese is then taken out of the vat, and in lieu of which a wooden girth or hoop is made use of, equal in breadth nearly to the thickness of the cheese: in this it is placed on the salting-benches, where it stands about eight days, being well salted all over, and turned each day. The cheese is then washed in luke-warm water; and after being dried with a cloth, it is placed on the drying-benches, where it remains about seven days: it is then washed in warm water, as before, with a brush, and wiped dry with a cloth: after it has stood about two hours from this washing, it is smeared all over with about two ounces of sweet whey butter, and then placed in the warmest part of the cheese-room.

Cheese-Room.

During the first seven days it is rubbed every day well over, and generally smeared with sweet whey butter. Afterwards a circular space is left unrubbed of four or five inches diameter, in the centre of each side the cheese, which, as long as it is afterwards kept, is, or should be, turned daily, and rubbed three times a week in summer and twice in winter. Scraping the rind should be rendered unnecessary by frequent cleanings. In a warm room the coat will be easily prevented from rising. These cheese-rooms are commonly placed over the cow-houses, and this is done with a view to obtain that moderate and necessary degree of temperature so essential to the ripening of cheese, to which the heat arising from the cattle underneath is supposed very much to contribute. The most desirable covering for a cheese-room, as contributing to that temperature so much desired, is thatch, for reasons that must be obvious. Before the cheese is brought into the rooms, the floors are mostly well littered with what the farmers here call *sniddle*, though wheat straw is frequently made use of for this purpose, but the knots of it are apt to leave an impression on the cheese. The afterneath of grass well dried seems to be a good substitute for sniddle.

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No. 33.

Description of an Apparatus of Tubes for facilitating the driving of Copper Bolts into Ships. By Mr. Richard Phillips.*

(With an engraving.)

MR. Richard Phillips, of Bristol, in several letters sent to the Society, states, that he had invented a method of driving copper bolts into ships, without splitting the heads or bending them; and that by means of tubes contrived by him for the purpose, this could be effected without difficulty, and had been satisfactorily executed in the presence of several of the principal ship-builders of Bristol.

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* Nicholson, vol. 3, p. 36. From the *Transactions of the Society for the Encouragement of Arts, &c.* for 1801.—The Society adjudged a reward of forty guineas to the inventor. Models are in their repository.

A certificate accompanied these letters, from Mr. William James, and Mr. Samuel Hast, ship-builders, and also from Mr. George Winter, of Bristol, testifying that they had tried the experiment of driving copper bolts through the jointed cylinder invented by Mr. Phillips; and that they so far approve of it, that they mean to adopt the general use of them, for driving bolts in all directions, particularly on the outside of ships, whether iron or copper; as this method not only prevents the bolts from bending, but keeps the heads from splitting, and enables the bolts to be driven much tighter, than by any other means with which they were acquainted. They further add, that by the application of Mr. Phillips's cylinder and punch, a copper bolt which had been crippled at the edge of the hole, and which could not be started by a mall, went up with ease in a perpendicular direction in the flat of a ship's bottom, not four feet from the ground.

This certificate was witnessed by Mr. William Holden.

The same facts are also certified by Mr. Thomas Walker, and Mr. James M. Hillhouse, of Bristol, who add their opinion, that the adoption of this invention in the different dock-yards of the kingdom, will prove very advantageous.

Since Mr. Phillips's first application to the Society for a premium, he has made a considerable improvement in the construction of his tubes. The description and engraving hereunto annexed are of the improved kind: models of both are, however, preserved in the Society's repository, for public inspection.

The instrument employed for driving the bolts, consists of a hollow tube formed from separate pieces of cast iron, which are placed upon the heads of each other, and firmly held thereto by iron circles or rings over the joints of the tubes. The lowest ring is pointed, to keep the tube steady upon the wood. The bolt being entered into the end of the hole bored in the wood of the ship, and completely covered by the iron tube, is driven forward within the cylinder by an iron or steel punch, placed against the head of the bolt, which punch is struck by a mall: and as the bolt goes further into the wood, parts of the tubes are unscrewed and taken off, till the bolt is driven home into its place up to the head.

The tubes are about five inches in circumference, and will admit a bolt of seven-eighths of an inch in diameter.

Reference to the Engraving of Mr. R. Phillip's Method of driving Bolts into Ships. Plate 5, Fig. 3, 4, 5, 6.

Fig. 3.

A. The copper bolt, with one end entered into the wood, previous to fixing the tube.

B. A piece of timber, or ship's side, into which the bolt is intended to be driven.

Fig. 4.

CCCC. The parts of the iron tube fastened together, ready to be put on the bolt A.

DDDDD. Iron or brass rings with thumb-screws, placed over the joints of the tube, to hold them firm together.

EEEEE. The thumb-screws, which keep the rings and tubes firm in their proper places.

F. Two points formed on the lower ring: they are to stick into the timber, and to enable the tube to be held firm in its place.

Fig. 5.

SHOWS the separation of the parts of the tube, which is effected by slackening the thumb-screws and rings.

To put them together, you slide the rings over the joints, placed as close as possible; then, by tightening the thumb-screws, you will have them firm together, and may continue the tubes to any length, from one foot to whatever number is required.

Fig. 6.

GH. Two steel punches or drifts, to be placed on the head of the copper bolt within the tube, whilst driving. The blow given upon the punch drives forward the bolt. The shortest of them should be used first, and, when driven nearly to its head, should be taken out of the tube, and the longer punch applied in its place.

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No. 34.

Description of a Water Wheel. By Mr. J. BESANT.*

[With an engraving.]

SIR—I beg leave to lay before the Society for the Encouragement of Arts, some observations respecting the common Undershot Water-wheel, and to point out the superiority of that of my invention.

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* Nicholson, vol. 3, p. 49. From the *Transactions of the Society for the Encouragement of Arts, &c.*

First,—In common water-wheels more than half the water passes from the gate through the wheel, without giving it any assistance.

Secondly,—The floats coming out of the tail-water are resisted with almost the whole weight of the atmosphere, at the instant they leave the surface of the water.

Thirdly,—The same quantity of water which passed between the floats at the head, must of course pass between them at the tail, and consequently impede the motion of the wheel.

In the water-wheel of my invention,

First,—No water can pass but what acts, with all its force, on the extremity of the wheel.

Secondly,—The floats coming out of the water in an oblique direction, prevent the weight of the atmosphere from taking any effect.

Thirdly,—Although the new water-wheel is heavier than that on the old construction, yet it runs lighter on its axis, the water having a tendency to float it.

Fourthly,—By experiments made with the models, proofs have been shown, that the new wheel has many advantages over the common wheel, and that, when it works in deep tail water, it will carry weights in proportion of three to one, so that it will be particularly serviceable for tide-mills.

I hope on trial, before the Society, my invention will prove successful, and am, &c.

J. BESANT.

No. 26, *Brompton.*

To CHARLES TAYLOR, Secretary.

Repeated experiments of the above invention were made by the Committee; from the result of which it appeared to possess some advantages over the common wheel, and to have a greater power of action.

Description of the late Mr. Besant's Water-wheel. Plate 5, Fig. 1 and 2.

A. The body of the water-wheel, which is hollow in the form of a drum, and is so constructed as to be proof against the admission of water within it.

B. The axis on which it turns.

C. The float boards, placed on the periphery of the wheel. Each board is obliquely fixed firm to the rim of it, and to the body of the drum.

D. The reservoir, containing the water.

E. The penstock, which regulates the quantity of water running to the wheel.

F. The current of water which has passed the wheel.

Fig. 2. Is a front view of the water-wheel, showing the oblique direction in which the float boards C are placed on the face of the wheel.

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No. 35.

Account of an Invention to secure the Pannels of Doors and Window Shutters from being cut out by House-breakers. By Mr. Joseph Davis.*

(With an engraving.)

SIR—I have for some time considered, that it would be of great benefit to the public, if a plan could be adopted to prevent the pannels of shutters or doors being cut out by house-breakers; and having tried a great number of experiments, I have at length succeeded in accomplishing the one I have the honour of forwarding to the Society for the Encouragement of Arts, &c.

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* Nicholson, vol. 21, p. 177. From the *Transactions of the Society of Arts*, vol. 25, p. 101.—Ten guineas were voted to Mr. Davis for this invention.

This improvement consists in introducing tempered steel wires through the pannels and stiles at the distance of three inches, thereby not only making a door or shutter far superior in strength, but calculated to defy the attempts of the house-breaker in taking out a pannel. This improvement, though so far superior to any hitherto known for appearance and utility, will be attended with less expense. I have submitted the above plan to Messrs. Paynters, Coleman street, likewise to Messrs. Moffat and Co. Paternoster row, and to several gentlemen in that line of business, who all do me the honour to say, that it far surpasses any thing of the kind, that they have ever known or conceived, and that it will completely answer the purpose.

I have also sent the machine on which I bored the pannel, conceiving it to be an additional recommendation; with this machine, a boy may with ease bore the shutters, &c. which otherwise might be difficult for a man to accomplish.—I have the pleasure most respectfully to subscribe myself, yours, &c.

JOSEPH DAVIS.

CERTIFICATE.—We hereby certify, that Mr. Davis's improvement on doors and shutters, to prevent the pannels from being cut out by house-breakers, is the best that we have ever seen; and we are of opinion, that its being known will be an advantage to the public, and do therefore recommend it to the Society for the Encouragement of Arts, Manufactures, and Commerce, for their consideration.

F. Paynter and Co. Coleman street.
E. Colebach, Minories.
J. Teasdale, Paternoster row.
W. Rolfe.

April 22, 1807.

Reference to the Engraving of Joseph Davis's Invention for securing Window and Door Pannels, Plate 5, fig. 7, 8, 9.

Fig. 7. Represents a wooden pannel made in the common way, the dotted lines show the situations of the tempered steel rods within the pannel, the holes through which the rods were introduced on one side being closed up.

Fig. 8. Shows a section of the same, the small dots in the engraving denoting the place of the rods.

Fig. 9. Shows the instrument on which the pannels are laid to be bored. The borer passes through the holes L M of the two upright pieces, which keep the borer in a straight line to act upon the pannel laid upon the frame N.

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No. 36.

On purifying Olive Oil for the Pivots of Chronometers.

By Ezekiel Walker, *Esquire.**

To Mr. Tilloch,

SIR—After all the experiments which have been made to decrease friction in time-keepers, nothing has yet been found to answer this purpose so well as oil. But it has long been known that the application of this fluid to marine chronometers is attended with very pernicious consequences: for it gradually loses its fluidity during a long voyage, and adheres to the parts of the machine, by which all regularity in its performance is destroyed. Hence I was led to suppose, that time-keepers might be improved if oil of a better quality, than that which had been commonly used, could be procured.

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* Tilloch vol. 36. p. 372.

About the year 1799, I made several experiments to separate from olive oil some of those impurities which it is known to contain, and I succeeded so far as to separate a thick mucilaginous matter from the best I could procure. This mucilage is an opake whitish matter, heavier than oil but lighter than water. The oil from which the mucilage has been taken is exceedingly transparent in a fluid state, but after it has been frozen it appears much whiter than common oil exposed to the same degree of cold.

About ten years ago I sent a small quantity of this oil to Mr. Barraud, requesting him to make trial of it, and in March, 1802, he gave me the following account:—

"I have," says Mr. Barraud, "just received a chronometer, in which the oil you favoured me with was used; which having performed a voyage of sixteen months to and from India, is vibrating as freely as at first, and keeping the rate it went out with to a fraction of a second."

Since that time Mr. Barraud has frequently applied to me for more of this oil, and continues to use it in his best time-keepers; but to be informed more particularly respecting it, I wrote to him requesting to know the result of his long experience, and the following extract is taken from his interesting answer:—

To Mr. Walker.

London, 13th October, 1810.

"DEAR sir,—It is, I believe, upwards of ten years since you first favoured me with some of your purified oil, which I have ever since constantly applied to my chronometers; and on their return from a long voyage I have always found your oil in good condition, much better indeed than any which I had before been able to obtain; nor has the superior quality of yours been confined to my own observation.

"The late Mr. John Brockbank was complaining to me, some years ago, of the bad state in which he found the oil in his chronometers on their return from India, many of which had failed in consequence, although the oil he used was the best he could obtain. I then mentioned the success which had attended yours, and at his request furnished him with a small quantity, which he applied to his chronometers, and afterwards very gratefully acknowledged the advantage he had derived from its use; having found, on the return of his chronometers from India, your oil in excellent condition, and deemed it far superior in quality, for such purposes, to any he had before been able to procure.

"I have presented one of the last phials, which you favoured me with, to Mr. Vulliamy of Pall Mall, who purposes to give it a trial; but I hope you will be induced, by what has been already ascertained, to make your discovery known. I am, &c.

P. P. BARRAUD."

Pure oil, such as I have at different times sent to Mr. Barraud, may be obtained by attending to the following directions.

Put a quantity of the best olive oil into a phial with two or three times as much water, so that the phial may be about half full. Shake the phial briskly for a little time, turn the cork downwards, and let most part of the water flow out between the side of the cork and the neck of the phial. Thus the oil must be washed five or six times.—After the last quantity of water has been drawn off, what remains is a mixture of water, oil, and mucilage. To separate these from each other, put the phial into hot water for three or four minutes, and most part of the water will fall to the bottom, which must be drawn off as before.

The oil must then be poured into a smaller phial, which, being nearly full, must be well corked, set in a cool place, and suffered to stand undisturbed for three or four months, or until all the water shall have subsided, with the mucilage on the top of it, and the oil, perfectly transparent, swimming upon the top of the mucilage. When *time* has thus completed the operation, the pure oil must be poured off into very small phials, and kept in a cool place, well corked, to preserve it from the air.

E. WALKER.

Lynn, November 13, 1810.

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NO. 37.

Account of the Methods employed for preventing Worms from destroying Bees. By DR. THOMAS CHAPMAN.

Wrightstown, Bucks County, December 3, 1812.

SIR—In the year 1808, the bees in my neighbourhood were attacked by a kind of worm, and many of the swarms destroyed. These worms had before appeared in the state of New York, and had gradually progressed through New Jersey, and I have now learned, that last year they were first observed in Chester County. From this it appears they are gradually progressing to the south, and will probably in a few years spread over the whole country. Their ravages are so destructive wherever they appear, that, unless some method of destroying them shall be discovered, they bid fair to exterminate the bees from our continent.

I therefore hope you will publish in the Emporium, for the information of the public, the following account of these worms, and of the methods that have been made use of to prevent their ravages.

The worms are of a light yellow colour; the body consists of twelve rings, and it has fourteen feet; the head is of a dark brown colour. They very much resemble a worm we often find in granaries of wheat. They are of various sizes; the largest about as thick as a writing quill, and an inch and an half in length.

These worms may be found in the mornings under the edges of the hive, where they lay out of the reach of the bees. When they have greatly increased, they either destroy the bees, or drive them from the hive. The combs will then be found nearly destroyed, and the remains of them matted together by a web, similar to a caterpillar's nest. I am not certain whether they devour the honey or the young bees; but, whenever I have raised a hive from the bench, if the worms had committed great ravages, I have found young bees under the hive; these bees, I have frequently observed, were half devoured.

After the worms have grown to their full size, they wrap themselves up in a very firm covering; and in about two weeks appear in the form of a moth, or what is commonly called a miller. These moths are of a light brown colour, and very much resemble those we see on summer evenings flying about our candles. Every evening they may be seen about the bee hives.

Several methods of preventing their destructive ravages have been practised in this neighbourhood. Placing the hive on four blocks, so as to raise it about two or three inches from the bench, has succeeded in a great many cases. This method leaves no harbour for the worms under the hive, and they are destroyed by the bees. The blocks must be removed before winter, or the bees will perish with the cold.

Another method that has been attended with success is to join the hive so closely to the bench, as to leave no harbour for the worms. But, perhaps, a much better method than either of the preceding, is to suspend the hive in the air by means of ropes. The worms have then no harbour. The hives must be placed on a bench before winter.

But, I believe, the most successful method yet discovered, is to raise the hive from the bench early in the morning, two or three times a week, and destroy the worms, which can be very easily done with a small stick. This method has, in many instances, proved completely successful, so that in the fall, when the bees were killed, not a single worm was to be found.

I have sent you some of these worms, which I this day took from a bee hive in this neighbourhood. If you are desirous of any further information respecting them, I will communicate it, if in my power, with great pleasure. Yours, &c.

THOMAS CHAPMAN.

To JOHN R. COXE, M. D.

NO. 38.

An Account of a New Method of increasing the charging Capacity of coated Electrical Jars, discovered by JOHN WINGFIELD, *Esquire, of Shrewsbury;*[*] *communicated by Mr.* JOHN CUTHBERTSON, *with some Experiments by himself on that Subject.*[†]

IN my treatise entitled *Practical Electricity and Galvanism*, page 103, I have said that breathing into coated electrical jars increased their charging capacity to such an astonishing degree, that their discharge would fuse four times the length of wire more than they could in ordinary circumstances; which I proved by experiments 147 and 156. Since that publication, large electrical batteries are become more general, and the number of jars increased; so that batteries containing thirty, sixty, and even a hundred jars are frequently met with; and, when so numerous, breathing into each jar is very disagreeable; and not only that, but in very dry states of the atmosphere, when most wanted, is even ineffectual, as those jars first breathed into lose that property which was produced in them by breathing, before the last can have obtained it: so that various other means have been tried; such as wetting the inside of the jars, and putting wet sponges into them, or by greasing and oiling the uncoated part in the inside; all of which gave very uncertain results, till John Wingfield, esquire, communicated to me, he had discovered, that pasting of paper on the inside and outside of the jars above the coating, had the effect of preventing the jars from exploding to the outside coating, and believed that their charging capacity would be increased thereby.

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[*] A gentleman who has lately very much distinguished himself, not only in the electrical science, but in all otherr branches of experimental philosophy.

[†] Tilloch, vol. 36, p. 259.

I embraced the first opportunity to try the effect of that discovery with single jars.

Experiment I.—I took a very thick jar (which had been used to show the phenomena of voluntary explosions without breaking) twelve inches high, and the coating nine inches, containing in the whole about one hundred and seventy-one square inches; it was applied to the conductor of a plate electrical machine, and six turns of the plate caused a voluntary explosion to the coating: the state of the atmosphere not being very dry, it required eight and twelve turns to produce a second and a third explosion: a fourth could not be produced; but when cleaned and dried as before, six turns caused a voluntary discharge.

Experiment II.—A slip of paper one inch broad was taken, of sufficient length to fit round the outside of the jar when the two ends were pasted together: this was slipped on to its outside to about one inch from the coating: the uncoated part being rubbed clean and dry, and applied to the machine, eleven turns of the plate produced a voluntary discharge to the outside coating.

Experiment III.—The paper ring was then slipped down to touch the coating, and then applied to the conductor: no voluntary discharge could be produced; and when discharged in the common way, its power did not seem to be increased,—to prove which,

Experiment IV.—The common discharging electrometer (which is always fixed to the basement of my machines) was used, to try to what distance the discharge could be made to pass from the knob of the conductor to the ball of the electrometer; which was found to be one inch and five-eighths.

Experiment V.—A piece of iron wire, one hundredth part of an inch in diameter and one inch in length, was hung to the electrometer, through which a second discharge was made to pass, and the wire was blued.

Experiment VI.—The paper ring was then taken off and breathed into twice; the discharge was then produced at the distance of two inches, and the wire was fused into balls.

Experiment VII.—The jar was then rubbed clean and dry, and a piece of the same sort of wire and the same length was hung to the electrometer in the same manner as before, and it appeared that the greatest charge it could take had not the least effect upon the wire: thus it appears that a paper ring so applied does not increase the charging capacity of jars in the same degree as breathing.

Experiment VIII.—The jar was highly charged, and examined in the dark: the paper ring appeared luminous all round the uppermost edge.

Experiment IX.—The ring was taken off, and pasted on in the inside close to the coating: twenty-three turns caused a voluntary explosion through the ring to the outside coating.

Experiment X.—A second ring three quarters of an inch broad was pasted on close to the other: the same number of turns produced a voluntary explosion, and the paper was torn by the discharge, which was repaired and left to dry.

Experiment XI.—When dry, no voluntary explosion could be obtained.

Experiment XII.—Its greatest power was then tried, and was found to be exactly the same as in Experiment VI, (when it was breathed into): it discharged at two inches distance, and the same length of wire was fuse into balls.

Further experiments and observations, setting forth the advantages that electricians are likely to obtain from the above discovery, will be the subject of a future paper.

NO. 39.

Description of the Optigraph (invented by the late Mr. RAMSDEN) *as improved and made by Mr.* THOMAS JONES.*

(With an engraving.)

THE methods used to facilitate the practice of drawing in perspective, as well for those versed in this polite art, as for those who have made less proficiency, have been various and numerous. Though some have supposed that the warmth of imagination and luxuriance of fancy, which impel the mind to the cultivation of the fine arts, are not to be confined to mechanical modes, yet upon observation and inquiry they will find that the most able and accomplished artists are often obliged to have recourse to some rules, and to use some mechanical modes to guide and correct their pencil: but so tedious is the operation, and great the difficulty, of representing objects in true perspective, that they trust mostly to their eye and experience for success. The result of such a mode of proceeding may be determined by portraits drawn by the best artists, and the different judgments formed concerning them. It has been well observed, that there is no artist who will be hardy enough to say that he can delineate by the eye the same object twice with exactness, and preserve a just and similar proportion of parts in each. In one of the figures we shall find some of the parts larger than in the other; both cannot be right: yet supposing them perfectly the same, neither may be conformable to nature. In addition to this, many situations of an object occur, which no eye, however habituated, can represent with accuracy.

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* Tilloch, vol. 28, p. 66.

On this account many attempts and various instruments have been made for the purpose of giving the outline of an object with accuracy.

The late most ingenious Mr. Ramsden, so well known for his inventions and improvements in various instruments, considered the present subject an object worthy of his attention, and invented the instrument I am about to describe, which is so simple and easy in its operation, that a person not possessed of the least knowledge of drawing, may, with less than three minutes' instruction, be perfectly able to take a perspective view of landscape, building, machinery, or, in fact, an object of any description presented to his eye, with the utmost correctness.

Mr. Ramsden left this instrument without the means of enabling the operator to enlarge or diminish his drawing; an inconvenience which I have obviated, while at the same time I have added some other trifling improvements. This instrument is certainly superior to any hitherto constructed for the same purpose; for in this the operator views the object through a telescope, which enables him to delineate minute objects with great exactness and ease, which are often too far from the eye to be seen sufficiently well to be delineated correctly.

Fig. 3, (plate 6,) is a perspective view of the optigraph. A represents the drawing board, on the outside frame of which is fixed the pillar of the instrument, B, by a clamp *a*. C is a tube, (sliding in the pillar,) on the top of which is fixed, by means of a screw *c*, the frame

D; at the end of this frame is a plain mirror E, beneath which is suspended, by a universal joint, the telescope F, of which G is the eye-tube. H are sliding tubes, capable of being shortened or lengthened in the same proportion as the inside speculum *c*, (fig. 4,) which is fixed to any place by the clamp screw P. The pencil L, of which *h* is the handle, slides perfectly easy, without shake, in the tubes H: the pencil is so contrived as to have all the freedom of a pen when held in the hand for use.

Fig. 4, represents a section of the telescope, being the principal part of the invention. The rays from an object entering the plain mirror *a*, are reflected into the telescope, passing through the object-glass *b*, and entering the speculum *c*, are reflected through the eye-glass *d*, to the eye at *e*: *f* is a piece of parallel glass, with a small dot on its centre, exactly in the focus of the eye-glass *d*.

Mode of Using the Optigraph.

Fix the drawing board to the table (by a clamp which is packed in the box) so that the surface of the mirror E is nearly parallel to the object; then take hold of the handle *h*, and hold the pencil on that part of the paper where you would wish the centre of your drawing, or any part thereof, to be. Then place your eye at the eye-tube G, and with your left hand alter the inclination of the mirror E until the small dot, described at *f*, in fig. 4, is on some particular part of the object that you wish to begin with, adjusting the telescope to distinct vision by the milled head P. Then by moving your hand (having the pencil) you pass the dot seen in the field of the telescope over the object, the pencil marking it at the same time on the paper.

To make your drawing larger, pull out the tube of the pillar C, fig. 3, and fix it with the screw *e*; then pull out the sliding tubes H, till the pencil is within half an inch of the paper, (in the middle of the board,) and proceed as before.

To make the drawing smaller, shorten the tubes C and H by sliding them in, and proceed as before.

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No. 40.

Description of an Instrument for drawing in true Perspective from Nature, and of another of considerable Simplicity and Cheapness for delineating Ovals. By R. B.*

[With an engraving.)

To Mr. Nicholson.

SIR—As I observe that you are willing, in your capacity of Journalist, to lay before the public any sketch or outline of invention that may promise to be useful, whether in its ultimate state of improvement or not, I am encouraged now and then to send my thoughts, queries, observations, or news, as they may occur. The following instruments are offered to your notice, in hopes they may appear in your excellent collection.

Fig. 1, *Plate* 6, is a sketch of an instrument for perspective, made some years ago by Dolland, and of which I know not the inventor. A telescope or camera is suspended vertically on a frame by an universal joint or jimbals. Horizontal rays A, are directed down the tube by a plane mirror B, and are again rendered horizontal, and turned to the eye through a side hole in the tube, by another mirror C. At the lower end is a pencil E sliding in a well-fitted socket, and pressed gently downwards by a weight or spring; or still better, by the hand only. The result or use is, that while the images are in succession brought into apparent contact with a point in the field of view, the pencil may be employed in tracing them in true perspective upon the table beneath.*

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* Nicholson, vol. 9, p. 122.

Fig. 2, represents a simple rule and string for drawing ovals on paper. A C B is a silken thread, fixed at A, and capable of being lengthened, shortened, and fixed by a screw B at the other end. This screw B can be placed, by a longitudinal groove in the ruler, at any distance from A, and can be made to pinch the thread upon any one of the divisions of the rule. At C is a pencil to be moved in the bend of the thread. It must be held upright, and it would be easy to contrive means of keeping it so; but it does not seem an object of sufficient necessity to add to the price of the instrument.

In the use, set A at one focus of the intended oval and B at the other. Allow the string to extend till the pencil marks the extremity of the conjugate diameter. Draw the semi-oval by moving the pencil along in the stretched thread: Then reverse the points A and B, placing them respectively on the foci occupied before by each other. Draw the other semi-oval, which completes the figure. I am, &c.

R. B.

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* There is an omission of the grey or rough glass, if the drawing be meant for a camera; or of the eye-piece, if it be a telescope. The first focal convergence must be made in these, and not at the eye.—NICHOLSON.

No. 41.

On Chemical Printing, and particularly on the Progress of this Art in Germany. By Mr. Marcel de Serres.*

Vienna, October 17, 1809.

THE art of printing from stone, known in Germany by the name of *chemische druckerey,* "chemical printing," originated in Germany; whence it spread first into England, then into Italy, and lately into France. It was invented by Aloys Senefelter, who was born at Prague, in Bohemia. Nine years ago he obtained of the king, formerly elector of Bavaria, an exclusive patent for its use for thirteen years; but he afterward sold the right to his brothers. Some time after Senefelter sold his right also to Mr. Andrew von Offenbach, who at present exercises the art in England. In 1802 he came to Vienna, to solicit a patent, and in 1803 he obtained one from the emperor of Austria for ten years. Changing his mind, he parted with this patent to Messrs. Steiner and Krasnitzki, returned to Bavaria, and set up a chemical printing office at Munich in partnership with some other persons. Messrs. Steiner and Krasnitzki still continue the business at Vienna, under the patronage of the counsellor of regency Startl von Luchsenstein, who is a zealous promoter of every useful undertaking.

At the chemical printing office at Munich the art has attained the greatest perfection, that of Stutgard apparently being of much less importance. Mr. Chauvron was the first who obtained a patent in France for printing or engraving on stone, and Mr. Guyot Desmarets did not attempt it till after him.

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* Nicholson, vol. 26, p. 208. Abridged from the *Annales de Chimie,* vol 72, p. 202.

The processes employed are simple, but as only a brief account of them has yet been given, it may be of use at least to make known those followed in Germany.

In the chemical printing office at Vienna three different methods are employed; but that termed in relief is most frequently used. This is the general mode of printing music.

The second method is the sunk. This is preferred for prints.

The third method is the flat, or neither raised nor sunk. This is useful for imitating drawings, particularly where the impression is intended to resemble crayons.

For printing or engraving in this method a block of marble is employed, or any other calcareous stone, that is easily corroded, and will take a good polish. It should be two inches or two inches and a half thick, and of a size proportioned to the purpose for which it is intended. A close texture is considered as advangeous.

When the stone is well polished and dry, the first step is to trace the drawing, notes, or letters, to be printed, with a pencil. The design is not very conspicuous, but it is rendered so by passing over the strokes of the pencil a particular ink, of which a great secret is made. This ink is made of a solution of lac in potash, which is coloured with the soot from burning wax. This appears to be the most suitable black for the purpose. When the design has been gone over with this ink, it is left to dry, which commonly takes about two hours; but this depends much on the temperature and dryness of the air.

After the ink is dry, nitric acid, more or less diluted according to the degree of relief desired, is poured on the stone; and corrodes every part of it, except where defended by the resinous ink.

The block being washed with water, an ink similar to that commonly used for printing is distributed over it by means of printers' balls, a sheet of paper disposed on a frame is laid on it, and this is pressed down by means of a copper roller, or copper press. The beauty of the impression will necessarily depend on that of the design. These copper presses are very ingeniously constructed in Germany, and easily worked. Their weight is proportional to the method of printing used.

When the desired number of impressions is taken off, and the work is not intended to be used any more, the stone is polished anew; and thus it may be made to serve for thirty or forty different works.

The sunk, or chalk method differs from that termed in relief only in having the stone much more corroded by the nitric acid. This is chiefly employed for prints, and has the advantage of remedying that uniformity of tint, which is common to prints from the chemical press. It is natural, that the higher parts should take less of the ink, and the lower parts more, so that the impression has less monotony; a defect hitherto seemingly inherent in this mode of printing. For this method too the rollers must be stronger and heavier.

As this method is more expensive, it is given up: yet for prints, where some degree of effect is required, and more clearness, it is to be preferred. In this method nearly pure nitric acid is employed. Indeed when the art was first invented, pure nitric acid was always used; but soon after, to save expense, it was diluted with water; and since that it has been employed more or less diluted, according to the effect wished to be produced on the stone.

For the method in relief, as it is called, nitric acid with half water is used.

In the flat method less nitric acid is used. It is not to be supposed, that the surface is quite plain in this way; but the lines are very little raised, so that they can scarcely be perceived to stand above the ground but by the finger.

The works executed in stone are; 1, imitations of wood cuts: 2, imitations of engravings in the dotted manner: 3, drawings: 4, music: 5, all kinds of writing: 6, maps: 7, copperplates.

The advantages of this method are, that it has a peculiar character, which cannot be represented by any other mode, while it gives a tolerable imitation of other methods; and still more the celerity, with which it can be executed. A subject, that an artist could not finish in five or six days on copper, may be engraved on stone in one or two. While a copperplate printer is taking off six or seven hundred impressions, two thousand may be printed in this way. A copperplate will scarcely give a thousand good impressions, while in this way several thousands may be taken off, and the last be as perfect as the first. Thirty thousand have been taken off one design at Vienna, and the last was as beautiful as the first. This is intended to be carried still farther, for the purpose of printing bank notes. The most expert music engraver can scarcely execute four pages of music on pewter in a day, but the engraver on stone can finish twice as much in that time.

To enter into the particulars would take up too much room, but experience has shown, that this mode saves two thirds of the expense of engraving on copper or pewter.

After having mentioned the advantages of printing from stone, it is just to point out its disadvantages.

These are, the difficulty of giving that diversity of tone, which is admired in engravings. Thus for instance, the finest prints that this art has yet produced are unquestionably those, that have been executed at Munich* from those celebrated drawings, which from a whim, in which painters are apt enough to indulge, Albert Durer made in a prayer book. These prints are executed with spirit, and the stroke is frequently clean; but it is uniform, so that the print is somewhat gray and monotonous. The difference is still better perceived, on comparing these prints with those etched by the different masters themselves.

The same inconvenience is found in music, the uniformity that prevails rendering the music less easy to read.

We must not too hastily conclude however, that this new art is not important: we should endeavour to find means of remedying the inconveniences, that appear to arise from the mode employed. If such means be discovered, which we may hope from experience showing, that the manner of applying the acid and of drawing upon the stone are the points most important to improve, this mode of printing will combine a saving both of time and expense. The great number of copies too, that may be taken off, is not one of its least advantages.

It remains now to notice the differences, that appear to exist in the chemical printing offices of different cities. At Milan a little nitric acid is poured over the stone, as at Vienna: but it is said, that they cannot take off above five hundred impressions. This must be owing to the nature of the stone employed, which is procured from Verona.

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* Albrecht Durers Christlich mythologische Handzeichnungen. Strixner, Munich, 1808. Different inks have been used for prints, as black, red, violet, and green.

Chauvron, the first who set up a chemical printing office at Paris, after having traced the design on stone with a resinous ink, merely wets it with water, and wipes off the water from the design. Printing ink is then applied by beating in the common way with balls; and, as this does not adhere to the wet stone, the resinous strokes only produce an impression. Chauvron is said to have printed a great deal of music in this way.

We must observe, that, where nitric acid is not used, the prints will never be so fine, and so many impressions cannot be taken off. The use of nitric acid therefore cannot be too strongly recommended.

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NO. 42.

Account of a Composition for preserving Weather-boarding, &c. By WILLIAM PATTENSON, *Esquire.*[*]

I HAVE often thought something much wanted for preserving weather-boarding, &c. from the injuries of the weather. Tar and oker, and other mixtures recommended for the purpose, I have tried, but do not find they answer. I therefore made many experiments to discover a composition better adapted to the purpose, and think I have found one which answers my expectation: it is impenetrable to water, is not injured by the action of the weather, or heat of the sun, which hardens it, and consequently increases its durability; it is much cheaper than paint, and more lasting.

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[*] Repertory of Arts, vol. 8, p. 126. From the *Transactions of the Society for the Encouragement of Arts, &c.*

The composition is as follows: three parts of air-slaked lime, two of wood-ashes, and one of fine sand, or sea-coal ashes; sift these through a fine sieve, and add as much linseed-oil as will bring the mixture to a consistence for working with a painter's brush. Great care must be taken to mix it perfectly: I believe grinding it as paint would be an improvement. Two coats are necessary; the first rather thin, the second as thick as can conveniently be worked. From the nature of this composition, there is no doubt but it is very durable; as it certainly will improve in hardness by time, and is much superior for the purpose to any thing I know of.

NO. 43.

*Instructions respecting the Purification of Saltpetre, drawn up by Order of the Committee of Public Safety of Paris; by whose Order also this Process is adopted in all the Laboratories of France.**

THE crude saltpetre is first to be bruised with wooden beaters, that the water, with which it is afterwards to be washed may more easily act upon every part of it.

The saltpetre, thus bruised, is then to be carried to proper tubs or vats, in each of which five or six hundred pounds may be put.

Water is to be poured upon the saltpetre, in the proportion of twenty parts to a hundred, and the mixture is to be well stirred.

It is then to be left to macerate or soak, till the liquor will dissolve no more. Six or seven hours are sufficient for this first operation; the liquor then indicates from twenty-five to thirty-five degrees, by the *pese-liqueur*.

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* Repertory of Arts, vol. 8, p. 199. From the *Annales de Chimie*.

This first washing is then to be drained off, and fresh water, in the proportion of ten parts to a hundred, is to be poured on the saltpetre.

The mixture is to be stirred, and left to soak for the space of an hour: the water is then to be again drained off.

Fresh water is to be once more poured on the saltpetre, in the proportion of five parts to a hundred, which water, after stirring, is to be immediately drained off.

This drained saltpetre is then to be put into a cauldron, containing fifty parts of boiling water to a hundred. When the saltpetre is dissolved, the solution ought to indicate from sixty-six to sixty-eight degrees, by the *pese-liqueur*.

The solution is then to be carried to a crystalizing vessel, in which, by cooling, about two thirds of the saltpetre made use of will be precipitated; the precipitation begins in about half an hour, and finishes from four to six hours afterwards. But, as it is of importance that the saltpetre should be obtained in the form of thin needles, because in this form it is more easily dried, it is necessary that the liquor in the crystalizing vessel should be stirred the whole time the precipitation is forming. The stirring is performed by means of a kind of rake, which gives a slight motion to the mass of liquor, and causes the crystals to be precipitated in the form of thin needles.

As the precipitation takes place, the crystals are to be brought to the border of the crystalizing vessel; to be taken up with a skimmer, and put to drain in baskets placed, for that purpose, upon frames, in such a manner that the water which runs from the crystals, may fall again into the crystalizing vessel; or it may be received in basons placed under the baskets.

The saltpetre is then to be thrown into wooden boxes, formed like the hopper of a mill, and having a double bottom. The upper bottom is supported, by means of pieces of wood, about two inches above the lower one, and is pierced full of small holes; through these holes the liquor drains off, and finally passes, through a hole made in the lower bottom, into a reservoir beneath. In these boxes the saltpetre is to be washed, with five parts of water to a hundred; this water may be used for dissolving the saltpetre, in future operations.

The saltpetre, after being well drained, and exposed to the air for some hours, upon proper tables for drying it, may be afterwards made use of for making gunpowder.

But, when it is intended to make use of the saltpetre for making gunpowder according to the process followed since the revolution, it must be much more highly dried. This may be accomplished by placing it in a stove; or, what is more simple, by heating it in a shallow cauldron. For this purpose, a layer, five or six inches in thickness, is to be put in the cauldron, which is to be heated to 40 or 50 degrees of Reaumur's thermometer.

The saltpetre is to be stirred for two or three hours, and to be so much dried, that, when strongly pressed in the hand, it does not acquire any consistence, nor retain any form, but appears like fine dry sand.

This degree of dryness is not necessary, when the gunpowder is to be made by beating with pestles.

It is then evident that, according to the method of purification we have prescribed, there are two kinds of liquor to consider; first, the water from the various washings of the crude saltpetre; secondly, the water from the crystalizing vessels.

The washing of the crude salpetre is repeated three times, as we have already mentioned.

In these three operations, thirty-five parts of water to a hundred of saltpetre, according to the quantity of it meant to be purified, are employed in washing.

These washings are founded upon the principle which establishes, that cold water dissolves the muriate of soda, (sea-salt,) the earthy nitrates and muriates, and the colouring principle, while it scarcely acts upon the nitrate of potash, (pure saltpetre.)

The water from these three washings, therefore, contains the muriate of soda, the earthy salts, the colouring principle, and a small portion of nitrate of potash, the quantity of which is in proportion to the muriate of soda, which determines its solution.

The water from the crystalizing vessels contains that portion of muriate of soda, and of earthy salts, which were not dissolved by the washings, also a more considerable quantity of nitrate of potash than was contained in the water of the washings.

The water which is employed at the end of the process, to wash and whiten the crystals placed in the wooden box, holds in solution only a small quantity of nitrate of potash.

These liquors therefore are of a very different nature.

The waters proceeding from the washings, may properly be called mother-waters; they ought to be collected together in basons, and treated with potash, according to the usual method. At the refinery called *de l'Unité*, they are evaporated to sixty-six degrees, and the muriate of soda is taken away, as fast as it is deposited; this solution is saturated with potash, in the proportion of two or three to the hundred; it is then suffered to settle, and the liquor is afterwards decanted into crystalizing vessels, in which are thrown twenty parts of water to a hundred, that all the muriate of soda may be kept in solution.

The liquor which remains above the crystals, produced by this treatment of the mother-waters, may be mixed with the water of the first crystalization. The muriate of soda may be separated from this liquor by simple evaporation; and the nitrate of potash which it holds in solution may be obtained from it by cooling.

The small quantity of water made use of to whiten the refined saltpetre, contains only nitrate of potash; it may therefore be made use of for dissolving the saltpetre in the cauldrons.

From the foregoing account it is evident, that a laboratory destined for the purification of saltpetre, according to the process here described, ought to be provided with the following articles.

1. Wooden beaters for bruising the crude saltpetre.
2. Tubs or vats, in which the saltpetre is to be washed.
3. A cauldron, in which the solution is to be made.
4. A crystalizing vessel, of copper, or of lead, in which the liquor is to be cooled, and the saltpetre crystalized.
5. Baskets for draining the crystals.
6. A wooden box, in which the crystals are to be more thoroughly drained, and the saltpetre washed for the last time.
7. Scales for weighing the saltpetre.
8. Thermometers and *pese-liqueurs*, to determine the degree of heat, and that of consistence.
9. Rakes to stir the liquor in the crystalizing vessel.
10. Skimmers to take off the crystals and put them into the baskets.
11. Syphons or cranes to empty the cauldrons.

The number of these implements, and their dimensions, must necessarily vary, according to the quantity of saltpetre proposed to be purified.

Supposing it is wished to purify ten thousand pounds of crude saltpetre per day; the number of men and utensils, necessary for that purpose, may be determined according to the following calculation.

On Weighing and Bruising the Crude Saltpetre.

A piece of ground must be set apart, as near the magazine as possible, for the purpose of beating or bruising the crude saltpetre.

This ground must be covered with broad smooth stones, or with very thick boards.

For bruising the saltpetre, wooden beaters may be made use of, similar to those which are used for beating mortar.

Two men are sufficient for carrying the saltpetre to the magazine, for weighing it, and bruising it.

On Washing the Saltpetre.

As the three washings take up the space of two days,* and as each of the tubs or vats will contain only five or six hundred pounds of saltpetre, twenty of them will be necessary for the purification of ten thousand pounds.

These tubs are to be two feet and a half in height, and the same in breadth.

They must be constructed with the greatest care, that the water used in washing the saltpetre may not escape through them.

They should be firmly fixed upon a plane, slightly inclined, of such a nature that the water from the saltpetre cannot soak into it. This plane should be terminated by a gutter, to receive the water from the saltpetre, and to conduct it into a reservoir placed at the end of the row of tubs.

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* This neither agrees with the time stated, in the beginning of the paper, as necessary for the three washings, nor with what has just now been said, that ten thousand pounds may be thus refined per day. We notice this, lest our readers should think our translation erroneous.

These twenty tubs may be disposed in two parallel lines. The planes upon which they are fixed may be inclined towards each other; so that their union may form the gutter or channel which is to conduct into the common reservoir the water that runs off.

These tubs are to have an aperture at the distance of two fingers' breadth from the bottom; which aperture (besides the stopper which closes it) must have a grated or perforated cover.

Four men may be allotted to the washing of the saltpetre: they should also have the charge of carrying the saltpetre from the magazine to the tubs, and from the tubs to the cauldron.

It is hardly necessary to mention, that the tubs should be separate from each other, and disposed in such a manner that they may be easily served.

On the Cauldron.

A conical cauldron, five feet broad, and four feet deep, will supply three operations in the day; and consequently will suffice for the purification of fifteen thousand pounds of saltpetre.

One man is sufficient for the service of the cauldron.

On the Vessel for Crystalization.

The crystalizing vessel should be made of lead, or of copper, and should be placed as near the cauldron as possible.

It should be fifteen inches in depth, ten feet in length, and eight in breadth.

It should be fixed upon very solid ground, in such a manner that every point of the bottom may be supported. The stone or brick work on which it is placed, should be raised twelve inches above the ground; by this means, the brink of the crystalizing vessel will be twenty-seven inches above the ground, which will render the service of it more easy and convenient.

It appeared to us advantageous, to give the bottom of the crystalizing vessel an inclination of four inches (in the longitudinal direction only) from the sides to the centre.

The solutions from the cauldron may be emptied several times successively into the vessels after having taken away the deposition of crystals arising from each solution.

Four men seem necessary for the service of the crystalizing vessel. They must keep the liquor constantly stirred, by moving the rakes therein; they must continually bring towards the edges of the vessel the crystals which are formed; they must take them out with a skimmer, and carry them to the baskets which are to receive them, and in which they are to drain.

The same men may put the saltpetre into the wooden boxes in which the draining is completed, and may afterwards carry it into the magazine for purified saltpetre.

For want of a large vessel for crystalization, a shallow cauldron may be made use of.

On Drying the Saltpetre.

To render the saltpetre fit to be made use of in the preparation of gunpowder, as soon as it is purified, it may be dried by either of the two following processes. First, by exposing it to the open air, or to the sun, during some hours, upon such tables as are used for drying gunpowder. Secondly, by putting it into a shallow cauldron, and keeping it, for the space of two hours, in a heat of from 40 to 50 degrees.

In either case, the saltpetre must be incessantly stirred and shaken, that it may dry quickly and equally.

General Remarks on the foregoing Process.

A pretty long experience has shown us, that the process here described is the most simple, and the most economical.

But, to spare others the trouble of trying such means of improving this process as have occupied our attention, but which we thought it right to reject, we shall submit to them the following reflections.

1. It has been tried to dissolve the crude saltpetre; to crystalize it; and afterwards to wash it, in order to separate the sea-salt from it.

This process at first sight appears more advantageous, because it is then unnecessary to bruise the saltpetre, but it is attended with great inconveniences. First, the crude saltpetre, dissolved in fifty parts of water to a hundred, and poured into the crystalizing vessel, does not deposit the same quantity of saltpetre as when it is washed before it is dissolved. This difference takes place, because the sea-salt, which exists in the crude saltpetre, facilitates the dissolution of the nitrate of potash; and consequently, the water in the crystalizing vessel must necessarily hold in solution a greater quantity of nitrate of potash, when the crude saltpetre is dissolved, than when it is previously washed in cold water, and thereby deprived of the sea-salt it contained. Secondly, the washing of the saltpetre, when done after its dissolution and crystalization, requires forty or fifty parts of water to a hundred, instead of thirty-five.

2. It has been tried to dissolve the saltpetre in twenty or twenty-five parts of water to a hundred; to take away the muriate of soda, as fast as it is precipitated by the boiling of the liquor: to dilute this solution with thirty

parts of fresh water to a hundred, and then to carry it to the crystalizing vessel. It was supposed, that by this means, the washings with cold water might be omitted, or considerably diminished. But, a continued boiling, kept up for four or five hours, in order to separate the sea-salt, is attended with a great waste of time, of fuel, and of saltpetre; and the washings are still indispensably necessary, both to take away the colouring matter, and to extract the last portions of sea-salt.

3. It may be supposed, that it would perhaps be possible to diminish the quantity of water used in washing; but we must observe, that it is to be feared, that when the saltpetre contains a great quantity of sea-salt, the purification of it would not be complete, if a less quantity of water were made use of than that we have prescribed.

4. One might perhaps be tempted to diminish the quantity of water made use of in the solution; but we are convinced, by repeated experiments, that the proportion we have pointed out is the most proper: if it is augmented, the saltpetre remains dissolved in the liquor; if it is decreased, it congeals or precipitates itself in a mass. We found, by observation, that the degree of saturation, most proper for our operations, was between the sixty-sixth and sixty-eighth degree of the *pese-liqueur.*

5. It might also be thought, that it would be more simple, and more economical, to treat the solutions of crude saltpetre with potash; but it is to be feared, that by so doing, a part of this alkali might have the effect of decomposing the muriate of soda, and converting it into muriate of potash; and it must be observed, that the last-mentioned salt is by no means proper for decomposing earthy nitrates, whatever some able chemists may have said of it.

It therefore appears more proper, not to treat the mother-waters, nor to make any use of potash, till all the sea-salt has been separated by evaporation.

No. 44.

Some Account of a Journey to the Frozen Sea, and of the Discovery of the Remains of a Mammoth. By M. MICHAEL ADAMS. *Translated from the French*[*]

I SHOULD have reason to reproach myself were I to delay any longer the publication of a discovery in Zoology, which is so much the more interesting to be detailed, as it once more presents to our view a species of animal, the existence of which has been a subject of dispute among the most celebrated naturalists.

I was informed at Jakoutsk by M. Popoff, who is at the head of the company of merchants of that town, that they had discovered upon the shores of the Frozen Sea, near the mouth of the river Lena, an animal of an extraordinary size: the flesh, skin, and hair, were in good preservation, and it was supposed that the fossile production, known by the name of mammoth horns, must have belonged to some animal of this kind.

Mr. Popoff had, at the same time, the goodness to communicate the drawing and description of this animal; I thought proper to send both to the President of the Petersburgh Academy. The intelligence of this interesting discovery determined me to hasten my intended journey to the banks of the Lena as far as the Frozen Sea, and I was anxious to save these precious remains, which might perhaps otherwise be lost. My stay at Jakoutsk, therefore, only lasted a few days. I set out on the 7th of June 1806, provided with some indispensable letters of recommendation, some of which were addressed to the servants of the government, and others to merchants, from whom I hoped to derive some advantages. On the

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[*] Tilloch vol. 29. p. 141.

16th of June I arrived in the small town of Schigarsk, and towards the end of the same month I reached Kumak-Surka: from this place I made an excursion, the express object of which was to discover the mammoth. And I shall now give a sketch of my journey.

The contrary winds, which lasted during the whole summer, retarded my departure from Kumak-Surka; this place was then inhabited by forty or fifty Toungouse families of the Batouline race. Fishing was their ordinary occupation, and the extreme activity of these people filled me with admiration: the women, old men, and even children, laboured with indefatigable assiduity in laying up provisions for winter. The strongest went a-fishing, the less robust were occupied in cleaning and drying the fish. The whole shores were covered with scaffolding, and the cabins so filled with fish that we could scarcely enter them. An innocent gaiety reigned in every countenance, and all exhibited the utmost activity. The fishermen sang while casting their nets, and others were dancing the Charya, which is a dance peculiar to the country. I cannot sufficiently express the emotions of joy which I felt at the sight of these pleasing scenes.

I was convinced, while upon the spot, that the inhabitants of the North enjoy happiness even in the midst of the frozen regions.

But what astonished me still more, was the picturesque view of the opposite side of the Lena.. This river, which is one of the largest in Siberia, majestically rolls its waters through the mountainous chain of Verschéjansk: it is here, near its mouth, entirely devoid of islands, and much narrower, deeper, and more rapid than in any place of its course. The mountains here appear in a great variety of forms; they are of a brilliant whiteness, and of a savage and horrid aspect; sometimes they represent immense columns which rise into the clouds, sometimes they resemble the ruins of ancient forts, and as if they were parts detached from the mutilated remains of grotesque and gigantic figures.

Further off, the horizon is terminated by a chain of high mountains, where eternal snow and ice dart back the rays of the sun.

These landscapes are of exquisite beauty; an expert draughtsman would look in vain for similar views in any other place of Siberia; and I am not astonished that the picturesque situation of Kumak-Surka should become the object of a national song, known solely on the shores of the Frozen Sea. I reserve the communication of this curious article until I publish the detailed account of my journey.

The course of the winds having at last changed, I thought of pursuing my route, and I had my rein-deer brought across the river. Next day at day-break, I set out accompanied by a Toungouse chief, Ossip Shoumachoff, and by Bellkoff, a merchant of Schigansk, and attended by my huntsman, three Cossacs, and ten Toungouses.

The Toungouse chief was the first person who discovered the mammoth, and he was proprietor of the territory through which our route lay. Bellkoff the merchant had spent nearly his whole life on the shores of the Frozen Sea. His zeal, and the details he procured me, have the strongest claims to my gratitude: I am even indebted to him for the preservation of my life at a moment of imminent danger.

At first I found great difficulty in sitting upon a rein-deer; for, the saddle being attached by a girth of leather only, it was very insecure, and often occasioned me very disagreeable falls. Besides, my position was very inconvenient for want of stirrups, which are never used among the Toungouses.

On our route we traversed high and rugged mountains, valleys which followed the course of small rivulets, and parched and savage plains, where not a shrub was to be seen. After two days travelling, we at last approached the shores of the Frozen Sea. This place is called by the Toungouses Angardam, or terra firma. In order to attain the mammoth, it was necessary to traverse another isthmus, called Bykoffskoy-Mys or Tumut. This isthmus, which projects into a spacious gulf, is to the right of the mouth of the Lena, and extends, as I was informed, from South-east to North-east for about thirty or thirty-five wersts.* Its name is probably derived from two points in the form of horns, which are at the north extremity of this promontory. The point upon the left hand, which the Russians call by way of eminence Bykoffskoy-Mys, on account of its greater extent, forms three vast gulfs, where we find some settlements of Jakouts: the opposite point, called Manstach on account of the great quantity of floating wood found upon its shores, is one half smaller; its shore is lower, and this district is completely inhabited. The distance from the one point to the other is estimated at four leagues and a half, or forty-five wersts. Small hills form the higher part of the peninsula of Tumut; the remainder is occupied by lakes, and all the low grounds are marshy.

The principle lakes are: 1st, Chastirkoöl, which means the lake of geese; 2d, Kourilakoöl; 3d, Beulgeuniachtachkoöl, the lake of hillocks; 4th, Omoulachkoöl; 5th, Mougourdachkoöl, where a particular kind of salmon is found called tchir; and 6th, Bachofkoöl. The lake No. 4 is the largest, and No. 5 is the deepest of all. The lake No. 6 derives its name from two famous adventurers, Bachoff and Schalauroun, who spent a whole winter on its banks. We still see the ruins of a cabin in which they resided. The history of their unfortunate end is told by M. Sauer in his Journal of Billings's expedition.

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* Ten wersts are equal to six English geographical miles.

The isthmus we have mentioned is so narrow at some places that the sea may be seen on both sides. The rein-deer perform a periodical transmigration every year, during which they abandon these places, in order to proceed by the Frozen Sea towards Borschaya and Uitjansk, and for this purpose they collect in large troops about autumn. In order to hunt these animals with greater prospect of success, the Toungouses have divided the peninsula into cantons, separated by palings. They frighten the deer by loud cries, which they utter all at once, by letting dogs loose at them, and by fans which they attach to the palings, and which are agitated by the wind. The terrified rein-deer throw themselves into the water in order to reach some neighbouring island, where they are pursued and killed by the hunters.

On the third day of our journey we pitched our tents a few hundred pases from the mammoth, upon a hillock called Kembisagashaeta, which signifies the stone with the broad side.

Schoumachoff related to me the history of the discovery of the mammoth in nearly the following terms:—

"The Toungouses, who are a wandering people, seldom remain long in one place. Those who live in the forests often spend ten years and more in traversing the vast regions among the mountains: during this period they never visit their homes. Each family lives in an isolated state from the rest; the chief takes care of them, and knows no other society. If, after several years absence, two friends meet by chance, they then mutually communicate their adventures, the various success of their hunting, and the quantity of peltry they have acquired. After having spent some days together, and consumed the little provisions they have, they separate cheerfully, charge each other with compliments for their respective friends, and leave it to chance to bring them together again. Such is the way of life of these innocent children of Nature. The Toungouses who inhabit the coast differ from the rest, in having more regularly built houses, and in assembling at certain seasons for fishing and hunting. In winter they inhabit cabins, built close to each other, so as to form small villages.

"It is to one of these annual excursions of the Toungouses that we are indebted for the discovery of the mammoth. Towards the end of August, when the fishing in the Lena is over, Schoumachoff is in the habit of going along with his brothers to the peninsula of Tumut, where they employ themselves in hunting, and where the fresh fish of the sea furnish them with wholesome and agreeable nourishment.

"In 1799, he had caused to be built for his women, some cabins upon the shores of the lake Onroul; and he himself coasted along the sea shore for the purpose of searching for some mammoth horns. One day he perceived in the midst of a rock of ice an unformed block, which did not at all resemble the floating pieces of wood usually found there. In order to examine it more closely, he clambered up the rock and examined this new object all around; but he could not ascertain what it was. The year following he discovered in the same spot, the carcase of a sea-cow (*Trichecus Rosmarus*). He perceived at the same time that the mass he had formerly seen was freer from the ice. and by the side of it he remarked two similar pieces, which he afterwards found were the feet of the mammoth. About the close of the next summer, the entire flank of the animal and one of the tusks had distinctly come out from under the ice. Upon his return to the shores of the lake Onroul, he communicated this extraordinary discovery to his wife and some of his friends; but their manner of regarding the subject overwhelmed him with grief. The old men related on this occasion, that they had heard their forefathers say that a similar monster had formerly shown itself in the same peninsula, and that the whole family of the person who discovered it had become extinct in a very short time. The mammoth, in consequence of this, was unanimously regarded as auguring a future calamity, and the Toungouse chief felt so much inquietude from it, that he fell dangerously ill; but becoming well again, his first ideas suggested to him the profit he might gain by selling the tusks of this animal, which were of an extraordinary size and beauty. He therefore gave orders to conceal carefully the place where the mammoth was, and to remove all strangers from it under various pretexts, charging at the same time some trusty dependents not to suffer any part of this treasure to be carried away.

"But the summer being colder and more windy than usual, kept the mammoth sunk in the ice, which scarcely melted at all that season. At last, about the end of the fifth year afterwards, the ardent desires of Schoumachoff were happily accomplished: the ice which inclosed the mammoth having partly melted, the level became sloped, and this enormous mass, pushed forward by its own weight, fell over upon its side on a sand-bank. Of this two Toungouses were witnesses who accompanied me in my journey. In the month of March 1804, Schoumachoff came to his mammoth, and having got his horns cut off, he changed them with Baltounoff the merchant for merchandize of the value of fifty roubles. On this occasion a drawing of the animal was made, but it was very incorrect; they described it with pointed ears, very small eyes, horses' hoofs, and a bristly mane along the whole of his back; so that the drawing represented something between a pig and an elephant."

Two years afterwards, being the seventh from the discovery of the mammoth, a fortunate circumstance occasioned my visit to these distant and desert regions, and I congratulate myself upon having it in my power to ascertain and verify a fact, which would otherwise be thought so improbable.

I found the mammoth still upon the same spot, but completely mutilated. The prejudices against it having been dissipated, because the Toungouse chief had recovered his health, the carcase of the mammoth might be approached without any obstacle: the proprietor was content with the profit he had already derived from it, and the Jakouts of the neighbourhood tore off the flesh, with which they fed their dogs. Ferocious animals—white bears of the north pole, gluttons, wolves, and foxes—preyed upon it also, and their burrows were seen in the neighbourhood. The skeleton, almost completely unfleshed, was entire, with the exception of one of the fore feet. The spondyle, from the head to the os coccygis, a shoulder-blade, the pelvis, and the remains of the three extremities, were still tightly attached by the nerves of the joints, and by strips of skin on the exterior side of the carcase. The head was covered with a dry skin; one of the ears, well preserved, was furnished with a tuft of bristles. All these parts must necessarily have suffered by a carriage of eleven thousand wersts. The eyes, however, are preserved, and we can still distinguish the ball of the left eye. The tip of the under lip has been eaten away, and the upper part, being destroyed, exhibited the teeth. The brain was still within the cranium, but it appeared dry.

The parts least damaged are a fore foot and a hind one; they are covered with skin, and have still the sole attached. According to the assertion of the Toungouse chief, the animal had been so large and well fed, that its belly hung down below the knee joints. This mammoth is a male, with a long mane at his neck, but it has no tail and no trunk. The skin, three-fourths of which are in my possession, is of a deep gray, and covered with a reddish hair and black bristles. The humidity of the soil where the animal has lain so long, has made the bristles lose some part of their elasticity. The entire carcase, the bones of which I collected upon the spot, is four archines and a half high by seven long, from the tip of the nose to the coccyx;* without however comprehending the two horns, each of which is a toise and a half long, and both together weigh ten pouds.† The head alone weighs eleven pouds and an half.

The principal object of my care was to separate the bones, to arrange them and place them in safety: this was done with the most scrupulous nicety, and I had the satisfaction of finding the other shoulder-blade, which lay in a hole. I afterwards caused the skin to be stripped from the side upon which the animal had lain; it was very well preserved. This skin was of such an extraordinary weight, that ten persons who were employed to carry it to the sea side, in order to stretch it on floating wood, moved it with great difficulty. After this operation I caused the ground to be dug in various places in order to see if there were any bones around, but chiefly for the purpose of collecting all the bristles which the white bears might have trodden into the wet ground on devouring the flesh. This operation was attended with difficulty, as we wanted the necessary instruments for digging the ground: I succeeded however in procuring in this manner more than one poud weight of bristles. In a few days our labour was ended, and I found myself in possession of a treasure, which amply recompensed me for the fatigues and dangers of the journey, and even for the expenses I had incurred.

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* An archine is a little more than two feet English measure.

† A poud is forty pounds.

The place where I found the mammoth is about sixty paces distant from the shore; and from the fracture of the ice from which it slid is about one hundred paces distant. This fracture occupies the middle precisely between the two points of the isthmus, and is three wersts long, and even in the place where the mammoth was, this rock has a perpendicular elevation of thirty or forty toises. Its substance is a clear ice, but of a nauseous taste; it inclines towards the sea; its summit is covered with a bed of moss and friable earth half an archine in thickness. During the heat of the month of July a part of this crust melts, but the other remains frozen.

Curiosity prompted me to ascend two other hillocks equally distant from the sea; they were of the same composition, and also a little covered with moss. At intervals I saw pieces of wood of an enormous size, and of all the species produced in Siberia; and also mammoth horns in great quantities frozen between the fissures of the rocks. They appeared to be of an astonishing freshness.

It is as curious as it is difficult to explain how all these things are to be found collected here. The inhabitants of the coast call this kind of wood Adamsohina, and distinguish it from the floating wood, which descending the great rivers of Siberia falls into the ocean, and is afterwards heaped upon the shores of the Frozen Sea. This last kind they call Noahsohina. I have seen in great thaws, large pieces of earth detach themselves from the hillocks, mix with the water, and form thick and muddy torrents which roll slowly towards the sea. This earth forms in different places lumps, which sink in among the ice. The block of ice where the mammoth was found, was from thirty-five to forty toises high; and, according to the account of the Toungouses, the animal when first discovered was seven toises from the surface of the ice.

The whole shore was as it were covered with the most variegated and beautiful plants produced on the shores of the Frozen Sea; but they were only two inches high. Around the carcase we saw a multitude of other plants, such as the *Cineraria aquatica* and some species of *Pedicularis*, not yet known in natural history.

While waiting for the boats from Terra Firma, for which I had sent some Cossacs, we exerted all our endeavours to erect a monument to perpetuate the memory of this discovery and of my visit. We raised, according to the custom of these countries, two crosses with analogous inscriptions. The one was upon the rock of ice, forty paces from the shelf from which this mammoth had slid, and the other was upon the very spot where we found it. Each of these crosses is six French toises high, and constructed in a manner solid enough to brave the severity of many ages. The Toungouses have given to the one the name of the cross of the Ambassador, and to the other that of the cross of the Mammoth. The eminence itself received the name of Selichaeta or Mammoth mountain. This last will perhaps some day or other afford some traveller the means of calculating with sufficient precision how much the mountains of ice lose annually of their primitive height.

I made two additional excursions for the purpose of acquiring some more precise notions upon the nature of this peninsula, and my discoveries in zoology and botany perfectly answered my expectations. I found a great quantity of amber upon the shores; but in no piece whatever could I discover the least trace of any marine production. I should, perhaps, attribute this to the proximity of the river, and perhaps also to the depth of the sea, or abruptness of the shore. I had occasion to examine more closely the effects of the flux and reflux: this has escaped M. Sauer, who saw nothing of it at the mouth of the Colima.

Our Cossacs not having arrived in time with the boat, I was obliged to return to the continent with my reindeer, without waiting for them. The vessel, in the mean time, had cast anchor in the bay of Borchaya, three hundred wersts from the isthmus where I was. We arrived without any accident, after a journey of eight days. A week afterwards I had the satisfaction to see the mammoth arrive. Our first care was to separate, by boiling, the nerves and flesh from the bones; the skeleton was then packed, and placed at the bottom of the hold. When we arrived at Jakoutsk, I had the good fortune to purchase the tusks of the mammoth; and thence I despatched the whole for St. Petersburgh.

A question of some magnitude remains to be dissolved:—Are the mammoth and elephant animals of the same species, as asserted by Buffon, Pallas, Isbrand Ides, Gmelin, and, above all, Daubenton? or should we, in preference, rely upon the opinion of M. Cuvier, who asserts that the mammoth occupies the second place among the extinct species of animals? As I do not intend, in this place, to make an exact comparison of the skeletons of a mammoth and an elephant, I shall content myself with relating here some characteristic marks which distinguish the two species: I reserve for a particular memoir some more detailed observations upon this subject. I shall here recapitulate the motives which induced me to adopt the opinion of M. Cuvier.

1. If the writers whom I have mentioned have actually made, as I suppose, zootomical comparisons, they have been able to do so very incompletely, and upon detached pieces; for neither the head, nor the whole vertebræ, nor the feet of the mammoth covered with flesh and hair, and furnished with the sole, have ever yet been examined, when collected together, by any writer.

The presence of the coccyx, which finishes the vertebral column, convinces me that the animal has had a very short and thick tail, like its feet: besides, its being every where covered with bristles induces me to think that they cannot be those of an ordinary elephant.

2. The teeth of the mammoth are harder, heavier, and more twisted in a different direction than the teeth of an elephant. Ivory-turners, who have wrought upon these two substances, say that the mammoth's horn, by its colour and inferior density, differs considerably from ivory. I have seen some of them which formed in their curvature three fourths of a circle; and at Jakoutsk, another of the length of two toises and a half, and which were an archine thick near the root, and weighed seven pouds. It is to be remarked, that the point of the tusks on the exterior side is always more or less worn down: this enables the inhabitant of the Frozen Sea to distinguish the right from the left tusk.

The mammoth is covered with a very thick hair through the whole body, and has a long mane upon its neck. Even admitting that I doubted the stories of my travelling companions, it is nevertheless evident that the bristles of the length of an archine, which were also found upon the head, the ears, and the neck of the animal, must necessarily have belonged either to the mane or to the tail. Schoumachoff maintains that he never saw any trunk belonging to the animal, but it is probable that it was carried off by wild beasts; for it would be inconceivable that the mammoth could eat with so small a snout, and with such enormous tusks, if we do not allow it to have had a trunk. The mammoth, according to these indications, would consequently belong to the elephant species, and M. Blumenbach, in his system, actually calls it *Elephas primævus.*

To conclude:—The mammoth in my possession is quite different from that found near New York, which, from the description given in the Journal called the *Museum des Wundervollen,* had carnivorous teeth.* M. Cuvier has proved in a most satisfactory manner, that the mammoth is a particular species of antediluvian animals.

Another question still remains to be decided. Has the mammoth originally inhabited the countries of the pole, or those of the tropics? The thick hair with which this animal is covered seems to indicate, that it belonged to the northern regions;—to this it does not seem reasonable to start objections, although several writers have done so: but what remains inexplicable is, to ascertain, How came the mammoth to be buried in the ice? Perhaps the peninsula of Tumut has been slowly formed. In course of time a general inundation must have covered all the north part of the globe, and caused the death of this animal; which, after having floated for some time among the masses of ice, was finally driven by a gust of wind upon the sand-bank not far from the shore. The sea, upon afterwards retiring within its limits, must have buried the body of the mammoth. But of what use are all these hypotheses, even if they had a high degree of probability?—How can we reconcile facts which seem so contrary? Two years ago similar relics were found in the environs of Kirengsk, upon the banks of the Lena, at a greater distance from the sea, and they had fallen into the bed of the river: others have been found in provinces further south from the Wolga; and they have been discovered in Germany and in Spain. These are just so many incontestable proofs of a general deluge. We must believe that the country of the mammoth was of immense extent: but I shall not at present prosecute inquiries which might lead us into a labyrinth of hypotheses: I shall merely add, that it appears incontestable to me that there has existed a world of a very ancient date; and Cuvier, without intending it, gives evident proofs of this in his system, by the twenty-four species of animals, the races of which are extinct. In the mean time I beg the indulgence of the curious reader in the perusal of this essay. I purpose giving the osteology of the mammoth with all that precision which Camper has devoted to a similar work.

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* See Philosophical Magazine, vol. xiv, p. 162, 228, 332.

MICHAEL ADAMS.

Petersburgh, August 20, 1807.

No. 45.

New Process for cleaning Feathers from their animal Oil. By Mrs. JANE RICHARDSON.*

The Process.

TAKE for every gallon of clean water, one pound of quicklime; mix them well together, and when the undissolved lime is precipitated in fine powder, pour off the clear lime-water for use, at the time it is wanted.

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* Tilloch, vol. 25, p. 67. From the *Transactions of the Society for the Encouragement of Arts, &c.* 1805.—Twenty guineas were adjudged to Mrs. Richardson for this communication.

Put the feathers to be cleared in another tub, and add to them a quantity of the clear lime-water, sufficient to cover the feathers about three inches when well immersed and stirred about therein.

The feathers, when thoroughly moistened, will sink down, and should remain in the lime-water three or four days, after which the foul liquor should be separated from the feathers by laying them on a sieve.

The feathers should be afterwards well washed in clean water and dried upon nets; the meshes about the fineness of cabbage-nets.

The feathers must from time to time be shaken upon the nets, and as they dry will fall through the meshes, and are to be collected for use.

The admission of air will be serviceable in the drying. The whole process will be completed in about three weeks; after being prepared as above mentioned, they will only require beating for use.

Mr. Jolly, poulterer, of Charing-cross, attended a committee of the society appointed to inspect the feathers, and stated that Mrs. Richardson had bought from him forty pounds weight of feathers, in the state they were plucked from dead geese, and in such a condition that if they had been kept in the bag only four days, without being cleansed, they would have been very offensive; that the feathers exhibited by Mrs. Richardson appear to be the same he had sold her, but that they were now in a much cleaner state, and seem perfectly cleared from their animal oil.

The committee, in order to authenticate more fully the merits of Mrs. Richardson's process, requested Mr.

Grant, a considerable dealer in feathers, to furnish some specimens of feathers of different kinds in an unclean state, to be cleansed by Mrs. Richardson; in consequence whereof an application was made to Mr. Grant, and the following letter received from him:

SIR—I take the liberty of sending herewith three samples of feathers, on which the experiments may be tried; but should the quantity not be sufficient, on being favoured with your commands, shall with pleasure send any quantity necessary.

The bag No. 1, contains the commonest feathers we ever make use of—it is a Russian produce of various wild fowl; No. 2, gray Dantzick goose; No. 3, a superior kind of Dantzick goose.

The two first are in their raw state, just taken out of the bags in which they were imported; the last have been stoved the usual time, (three days,) but retain their unpleasant smell. Should it not be considered giving you too much trouble, shall be extremely obliged by your favouring me with a line when the experiment has been made, and I shall be happy in waiting upon you to know the result. I am, &c.

THOMAS GRANT.

To C. TAYLOR, M. D. Sec.

After the feathers last mentioned were sent back by Mrs. Richardson, Mr. Grant attended to examine them, and declared that they appeared to be perfectly well cleaned.

Certificates from Mr. Christopher Bushnan, Chelsea, and from Mr. W. Baily, testified to the efficacy of Mrs. Richardson's process.

No. 46.

New Method of cleansing Silk, Woollen, and Cotton Goods, without damage to the texture or the Colour. By Mrs. Ann Morris.*

Take raw potatoes, in the state they are taken out of the earth, wash them well, then rub them on a grater over a vessel of clean water to a fine pulp, pass the liquid matter through a coarse seive into another tub of clear water; let the mixture stand till the fine white particles of the potatoes are precipitated, then pour the mucilaginous liquor from the fecula, and preserve this liquor for use. The article to be cleaned should then be laid upon a linen cloth upon a table, and having provided a clean sponge, dip the sponge in the potatoe-liquor, and apply the sponge thus wet to the article to be cleaned, and rub it well upon it with repeated portions of the potatoe-liquor, till the dirt is perfectly separated; then wash the article in clean water several times, to remove the loose dirt; it may afterwards be smoothed or dried.

Two middle-sized potatoes will be sufficient for a pint of water.

The white fecula which separates in making the mucilaginous liquor will answer the purpose of tapioca, will make an useful nourishing food with soup or milk, or serve to make starch and hair-powder.

The coarse pulp which does not pass the sieve is of great use in cleaning worsted curtains, tapestry, carpets, or other coarse goods.

The mucilaginous liquor of the potatoes will clean all sorts of silk, cotton, or woollen goods, without hurting the texture of the article, or spoiling the colour.

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* Tilloch, vol. 25, p. 71. From the *Transactions of the Society for the Encouragement of Arts, &c.* 1805.—Fifteen guineas were voted by the Society of Arts to Mrs. Morris, for communicating this new process.

It is also useful in cleansing oil paintings, or furniture that is soiled.

Dirty painted wainscots may be cleaned by wetting a sponge in the liquor, then dipping it in a little fine clean sand, and afterwards rubbing the wainscot therewith.

Various experiments were made by Mrs. Morris in the presence of a committee, at the society's house: the whole process was performed before them upon fine and coarse goods of different fabrics, and to their satisfaction.

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No. 47.

List of American Patents.

(Continued from page 160.)

1808.

Antoine Boucherie, Jan. 8, improvement in making and refining sugar.

Eli Barnum, Jan. 9, machine to facilitate the making of boots and shoes.

Oliver Evans, Jan. 22, machine for manufacturing flour and meal.

Jonathan Hicks, Jan. 28, nail cutting machine.

John F. Gould, Feb. 1, improvement in fire places or open stoves.

Samuel Dodge, Feb. 9, improvement in the fanning mill for grain.

William Bent, Feb. 24, machine for splitting leather and skins.

Hezekiah Harris, Feb. 24, improvement in the plough.

Dan. Watson, March 4, improvement in the common suction pump.

Philemon Heaton, Mark B. Boyes, and Philemon Heaton, junior, improvement in propelling boats.

Robert Fulton and Nathaniel Cutting, March 4, machine for manufacturing cordage and improving its quality, &c.

Phineas Pratt, March 5, machine for making combs.

Simeon Hays, March 8, improvement in churns.

Eleazer Cady, junior, March 9, a forcing pump with double action, applied to engines, &c.

Nicholas King, March 10, a revolving churn.

Stephen Stackhouse, March 11, improvement in the churn.

Giles Gridley, March 13, improvement in chimneys.

Giles Gridley, March 14, improvement in fire places.

William Wadsworth, March 15, a washing machine.

William Wadsworth, March 15, machine for propelling boats, &c.

Obadiah Pease and Asher Donalds, March 18, machine for grinding bark and dye woods.

Ebenezer Benedict, March 21, improvement in the cyder and cheese press.

Eli Barnum and Benjamin Brooks, March 21, machine for distilling or boiling water.

John Johnson, March 21, a wheel to run under water.

William W. Townsend, March 22, improvement in churns.

Oliver Barret, jr. March 23, a fanning mill for grain or clover seed.

Roswell Hopkins, March 25, a lever for turning wheels, for rowing boats, &c.

Ele. Smith, March 30, machine for trimming straw plat, for bonnets.

Jedediah Tallman, March 31, mode of applying power and causing motion to machinery by the pendulum.

Joseph Poudrell, April 6, an economical furnace or stove.

Thomas Cohoon, April 11, cross cut saw machine.

Robert Kilborn, April 12, improvement in lessening the friction in axletrees of carriages, &c.

Ephraim Warner, April 12, improvement in cheese presses, &c.

Thomas Cohoon, April 13, machine for breaking and swingling hemp and flax, &c.

Thomas Cohoon, April 14, improvement in the screw press.

Ira Ives, April 14, improvement in faucets for drawing liquor from casks.

William Coolidge, April 18, machine for smoothing and polishing paper and other substances.

Samuel Frothingham and George Harris, April 20, mode of striping alum dressed leather for shoe binding, &c.

John Fairbanks, April 21, a cylindric ruling machine.

Daniel Pierpont, April 22, improvement in the churn.

Timo. Cruttenden, April 23, improvement in the spinning wheel.

Roswell Pitkin, April 23, improvement in manufacturing hats, cloths, &c. from a fleece or sheet taken from a carding engine, without bowing.

Aaron Reed, April 25, improvement in the churn.

David Cobb, April 25, improvement in carriages for field artillery.

Nehemiah Howe, April 25, improvement in the churn.

Joseph Reeve, April 25, improvement in preparing and making twisted whalebone whips.

Benjamin Taylor, April 25, mode of impelling boats, water or land carriages.

Isaiah Jennings, April 25, machine for making rivets.

Daniel Rider, April 26, machine for making oakum.

Leonard Kennedy, April 26, a washing machine.

Ebenezer Stowell, April 26, machine for shearing woollen and other cloths.

Benjamin Dearborn, April 29, the anglet for taking and laying down angles.

Elam King, May 14, a washing machine.

Reuben Ainsworth, May 14, improvement in making pearl ash, in kettles, without the use of ovens.

William Flower, May 15, the life buoy, or seaman's friend.

John Bailey, junior, May 16, a friction roller door hinge.

Will. Rhodes, May 16, improvement in the construction of pumps.

William Rhodes, May 16, a floating dry dock for cleansing the bottoms of vessels.

Simeon B. Willard, May 18, improvement in the churn.

Rob. P. Cunningham, May 21, improvement in pressing machines.

Samuel Barber and Nehemiah U. Tompkins, June 1, improvement in the application of the whip saw.

Caleb Johnson, June 3, improvement in the double lever press for tobacco, &c.

Jesse Reed, June 3, machine for rasping dye woods.

En. Ives and Jerry Hill, June 3, improvement in carriage springs.

Samuel Stilwell and Daniel T. Wandall, June 3, apparatus for propelling boats across rivers by force of the current.

Martin Lee, June 4, improvement in washing machines.

Robert Patton, June 13, machine for washing, churning, and getting out clover seed, &c.

Joseph Jellef, June 14, machine to cut and head nails.

James Finley, June 17, improvement in the chain bridge.

Jonathan Mix, June 17, thorough-brace springs for carriages.

Allen Pollock, June 17, improvement in stoves, &c. for heating rooms.

Ebenezer Benedict, June 18, improvement in the cyder and cheese press.

Ebenezer Jones, June 20, a perpendicular washing machine

Ebenezer Jones, June 20, machine for sawing stone, wood, &c.

Simson Stewart, Ebenezer Hovey, and James Henderson, June 21, machine for shearing cloth.

David Burt, June 22, a hydrant for drawing water from aqueducts.

Osborn Parsons, June 23, improvement in rectifying spirits.

Winslow Lewis, June 24, improvement in lighting the binnacle of ships.

Robert Ramsey, June 24, improvement in making conduit pipes, &c. from clay, &c.

John Henry Ross, June 24, an illuminator for lighting stair cases.

James Armour, jr. June 27, folding or spiral springs for carriages.

Ezekiel Olds, June 29, machine for splitting boards, planks, &c.

(To be continued.)

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INTELLIGENCE.

Curious Fact.[*]

In the capital of the beautiful kingdom of Valencia, I learned the following facts from eye-witnesses. A silk weaver kept a stallion and a mule in the same stable. One night in winter the mule was taken ill, rolled on the ground, and appeared ready to die. At last it brought forth a foal, so well formed that the finest mare could not have produced a better. The stallion and mule were left together during eight years, in which time the latter brought forth five male and two female foals.[†] Now the mule was half horse, half ass; its offspring were half horse, half mule. But, will it be said that the latter, which were perfect horses, contained a portion of the ass, which portion of ass might have passed by the mule to become horse? Most assuredly no sensible person will say so. Nature has not instituted the mule species; and when in successive generations all traces of the ass are effaced in the foals of the mule, it is Nature which resumes her rights, and puts a limit to a race of monsters.

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[*] Tilloch, vol. 36, p. 390. From *Reflections on some Mineralogical Systems.* By R. Chenevix, Esquire, F. R. S. &c.

[†] As this fact has been questioned by some French theorists, from the forced and miniature experiments of Buffon, it is not foreign to the present subject to say, that the writer of this note has also heard it from unimpeachable eye-witnesses who were well acquainted with the whole circumstances, and that he knew a gentleman, an amateur mineralogist in Valencia, who found one of the offspring of the mule the most serviceable horse that he ever possessed.—*Translator.*

THE

EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 2.] FEBRUARY, 1813. [No. 10.

NO. 48.

Memoir on the Discovery of a Factitious Puzzolana, presented to the French National Institute, by M. DODUN, *Engineer in Chief of Bridges and Highways in France.**

THE deposited dust of ancient volcanic substances, has been long used in Flanders, and the adjacent countries, as a substitute for the Italian puzzolana, under the name of *trass*, or *ashes of Tournai.*

M. Faujas has proved by decisive experiments, made by order of government, that certain lutulent eruptions of ancient volcanoes at Vivarais, had the same qualities as the puzzolana of Italy, and might be used instead of it. M. Bagge, a Swede, is also known to have composed an artificial puzzolana cement, with a black, hard, and slatey schist; but until 1787, no one ever thought that the territory of France contained in abundance non-volcanic substances capable of taking place of the Italian puzzolana with economy and advantage.

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* Nicholson, vol. 12, p. 331. From the *Journal de Physique*, tom. 61.

The discovery which I here present, has, like many others of great utility, been the effect of chance.

The habit of examining the nature of stone in its bed, which enables the observer to judge of its qualities at first sight, fixed my attention on an immense quantity of calciform fragments of iron ore, in beds of from eight to ten feet thickness, following exactly the parallelism of the slightly inclined declivities, in the neighbourhood of Castlenaudery. I perceived in the adjacent fields many substances of the same nature scattered over the surface of the earth, of violet, brown, and black colours, which from their appearance, had a perfect resemblance to compact lava, which seemed extraordinary in a country where there was no appearance of ancient craters, or of volcanic eruptions. These I soon found out had been brought to this state by serving as hearths, or enclosures to the fires kindled in the fields by the peasants, either for agricultural purposes, or personal convenience when they watch their flocks in winter; as I saw soon after, many similar arranged by hand on one another for these purposes.

The similarity of these fragments to volcanic products excited my desire to form a cement from them, by treating them in the same manner as puzzolana earth. The great quantity of iron which these oxides seemed to me to contain, the abundance of their siliceous particles, and the alumen which evidently entered into their composition, their great weight, and their non-effervescence with acids, altogether made me presume, that the cement formed from them would bind under water, and my expectation was not deceived.

Fifteen months successive experiments, to discover the proportion of lime which this oxide would absorb to harden in water, without cracking when in the air, have convinced me, that my factitious puzzolana had all the good properties of that of Italy, without its faults. At this time I determined to propose its use in the public works, and demanded that comparative experiments should be made between it and the Italian puzzolana, in presence of the commissaries of the province of Languedoc, and of the directors of the canal which joins the two seas. Great blocks of *Beton* composition made with both cements, were thrown into the reservoirs adjacent to the lock of Saint Roch, at Castlemandery, being first plaistered over with the respective compositions.

Six months after, the water was drawn off from the bodies of masonry, and it was then seen that the factitious puzzolana had acquired a solidity at least equal to that of Italy. The plaister made with the Italian puzzolana was cracked and chapped, but that formed from the factitious kind had entirely preserved the unity of its surface.

The states of *Etats* of Languedoc altogether convinced of the authenticity of this discovery, by the results of the comparative trials of both kinds of cement which they had seen, and by the certificates of their commissaries, and persuaded of the great advantage it would be to France, decreed in 1789, in their last meeting, that the factitious puzzolana should not only be used instead of the Italian in the works under their direction; but moreover, that it should be demanded in favour of the author of it, as a testimony of public gratitude, that government should authorize the free circulation of it every where.

The great consumption of this factitious puzzolana obliged me to extend its manufacture, I formed a partnership with the proprietor of the ground. The foundation of an establishment on a great scale was laid at the mountain itself where the materials were found. The works carried on in its vicinity were likely to farther reduce the cost of the article, which was already one half less than that of Italy, and the public were about to enjoy the advantages of this manufacture, when the revolution paralysed every thing.

In 1791 I informed the constituent assembly of this discovery; the certificates which proved it, and the results of the experiments were deposited at the office; the matter was ordered to be examined by M. M. Pelletier and Berthollet, and the assembly considering, that this factitious puzzolana might be of the greatest use to France, decreed that two thousand francs should be granted to its author, which were paid accordingly.

On this occasion the celebrated Mirabeau declared the discovery to be so valuable, "*that if it had not yet been made, public encouragement should be held out to excite it.*"

The Constituent Assembly wished to have numerous similar establishments set on foot in France, so well were they convinced of its national importance; but the misfortunes of the times prevented the execution of a project, which the grand chief of the empire may easily realize, to the advantage of the country, whenever it seems good to him to do so.

Researches on the amelioration of our cements, and particularly on the nature of the materials proper to form artificial puzzolana, led me to try the calcination of various schists, of the bitumenous, ferruginous, and argillaceous sorts.

The black slatey schist of M. Bragge, so common in France, was not forgotten: It is almost the same as that which the elder M. Grathieu essayed at Cherboug last year; but I have constantly found that these schists always contain too little iron. I perceived that their repulsion of the water was slow and feeble, and that their solidification in the water was owing to the good quality of the lime.

I was thus obliged to recur to my quartzose oxides of iron, from their containing a greater quantity of ferruginous principles; and can aver with the skilful Faujas, that the puzzolanas owe their property of hardening in water solely to the ferruginous particles which they contain: of this I have had many proofs. This truth is farther demonstrated in the pudding-stones, the brescias, and generally in all the amygdaloides with a ferruginous base or cement.

The theory of our cements is but little advanced; perhaps we take simple conjectures for proofs relative to them. We effect the regeneration of silex, and of the carbonate of lime; we know the acid gases which perform the principal part in the affair: but in this important work we have been long ignorant of the degrees of their reciprocal affinity, their quantity, and the mode of their respective combinations. Our knowledge on this matter is confined to a few facts.

Many experiments have proved to me that the puzzolana, which soonest forms a body in the water, is not fit to be employed in the open air, where it cracks and chaps in all directions. And that which is proper for the air, and which acquires and preserves its tenacity in it, sets but imperfectly in water. This difficulty, of which the Institute will perceive the cause, has obliged me to keep two sorts of the factitious puzzolana; on the reciprocal use of which a memoir of instruction will accompany the sale. The two sorts may be distinguished by their colour.

The factitious puzzolana proper for works under water, is of a reddish-brown. That which is fit for works exposed to the air, is a dark violet. The latter is used for terraces, the embankments of basons, for the composition of inclosures, or for light roofs. Bridges of a single arch may be formed with it; and I have seen it adhere so strongly to glazed tiles, that it was necessary to break the tiles to detach it.

The puzzolana proper for constructions beneath the water, forms the most solid body in it. Three months after immersion it is an actual stone capable of receiving a polish. The lime in it is always regenerated into carbonate of lime in ten weeks.

When it may be thought by any one that he has been deceived as to the certainty of these effects, it will always be found, that he either has not observed the quantities directed of the puzzolana and the lime, or that he has used the reverse of that kind of the cement proper for the work.

I commonly used lime in the state of impalpable powder, slacked in Lafaye's manner, for works exposed to the air; and employed lime in the state of *putty*, for works which were to be covered with water. Sometimes I used lime in powder for the same work. This difference depends on the degree of goodness of the lime, on its greater or lesser richness, or its proportional poverty. Custom gives the advantage of knowing the different kinds on mere inspection.

The use of lime in powder appeared to me to merit a preference in the preparation of mortars or cements. I prepared my factitious puzzolana in a certain quantity as soon as I knew the proper proportion of the lime; and I had thus the advantage of being able to work it in troughs in the same manner as sulphate of lime. The whole was well mixed together and put into sacks; by which means the masons had nothing to do with the mixture of the articles, (which is too often left to unprincipled workmen,) and being thus master of the respective proportions of the puzzolana and the lime, I could always be assured of the solidity of my cements.

There remains for me to describe the exterior characters of the quartziferous ferruginous oxides, which form the basis of my factitious puzzolana, and to relate the analysis of them which I made about eighteen years ago. I will content myself with offering the comparative results with the Italian puzzolana, both in the dry way and the moist.

Exterior Characters of the quartziferous Oxides of Iron.

THEIR colour is of a reddish-brown before calcination, or slightly violet. A light torrification gives them a clearer red tint or a deep violet: one more intense renders them of a deep brown or of a violet-brown inclining to a black. The degree of the calcination for use is confined to those two states.

Urged at a longer continued heat, the colour becomes a deep black; then the substance becomes porous, entirely similar to certain lavas of our modern or ancient volcanoes, with which it is then difficult not to confound them.

Their fracture is grained and a little earthy, and small crystals of quartz may be distinguished in them by the naked eye, and almost always angular fragments of gray or milky quartz; a powerful magnifying lens causes in some fragments the discovery of needles of schorl, the amphibole of Hauy, and some small tourmalines.

Their smell is strongly argillaceous on breathing on them with the mouth.

There is no fire produced by the use of the steel, when it does not strike a quartzose particle.

They do not effervesce with acids either cold or hot.

The magnet acts a little on these oxides before calcination, and strongly, or perceptibly, after it.

The medium weight of a cubic foot is one hundred and twenty-five degrees; that of the Italian puzzolana is but ninety-one degrees.

Analysis by the moist Way.

I SHALL not weary the assembly by a detail of the manipulations relative to the solvents and re-agents which art uses for the decomposition of bodies, and shall only say, that silex, iron, alumen, and a small portion of manganese, are the constituent parts of these oxides.

I repeated these experiments many times, and had for a medium result from an hundred pounds, chemical weight,

50	parts of silex;
31	—— of iron;
16	—— of alumen;
3	—— of manganese, and loss.
100	

If this analysis be compared with that of the puzzolana of Italy, which contains in 100 parts—

50	of silex;
25	of alumen;
16	of iron;
3	of lime;
6	of loss;
100	

their respective properties may be appreciated according to the proportions of their integrant parts.

The excess of alumen causes the plaisters made from the Italian puzzolana to crack and chap in the open air: this fault arises from their great oxidation. I have been able to replace in them those principles which they lost by decomposition.

Analysis in the dry Way.

I ENDEAVOURED to obtain a regulus from these oxides of iron by using a violent heat. I followed the process of Kirwan for the fusion of siliceous and argillaceous ores of iron; yet I never obtained a single metallic button; and only found at the bottom of the crucible a vitrified mass of an opaque black, or a scoria in the state of crude cast iron.

Desirous to know if I could procure a malleable button by using the blowpipe, taking borax for the flux and supporting the oxide on charcoal; I still could only obtain a spongy ingot resembling crude cast iron, and breaking both when hot and when cold.

Being placed on a support of glass, (according to my method published in the Journal de Physique, tome 31, pages 116 and 139,) the oxide fused at the second attempt, the support was coloured green, and small grains of iron were seen to pass first of a dark-green colour, then of a bright green, and afterwards to disappear in evaporating. There remained on the globule only a slight tinge of blackish-green.

The result of all these facts seems to be, that this oxide is entirely deprived of its metallic principle, and that its super-oxigenation renders it reducible and refractory.

The arts may draw some advantage from these oxides, by using them in pigments for buildings. I succeeded after many washings, in extracting from them a beautiful brown-red colour equal to that of commerce, and applied it to use successfully.*

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No. 49.

Report made to the Institute on two Memoirs of M. Gratien Lepere, *on natural and artificial Puzzolana.*

By M. Chaptal.†

EVERY person is acquainted with the purposes to which puzzolana is applied in buildings under water. The property possessed by this volcanic substance of speedily becoming hard when mixed with sour lime, in the composition of cements for hydraulic purposes, has rendered it a most important article; but the difficulty of procuring it from Italy while the navigation of the seas is interrupted, has made it extremely scarce and dear. Attempts have therefore frequently been made to procure a substitute for puzzolana, in substances which are to be procured in all countries and at a low price.

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* This paper has been abridged in its introduction, in the details relative to negociations with the Constituent Assembly, and in some other points a little irrelevant to the puzzolana; but all matters directly tending to illustrate its nature and properties have been carefully copied.

M. Dodun's discovery may be of some use to this country, as there are in many parts of it large masses of iron-stone, and some is found in the vicinity of most coal-mines.

It has been long known that iron ochres have the same property of forming puzzolana with lime, when properly roasted, and this circumstance is mentioned at large in Chaptal's Chemistry. A patent has also been obtained in this country for the application of iron pyrites to the same purpose, the right to which was purchased long ago by Mr. Samuel Wyat. But the novelty of M. Dodun's discovery is, that poor iron-stone is equally fit for this use, as the other substances mentioned, which is of the more importance as it is very plentiful, and may often be procured in situations where the others cannot.

It may not be amiss to mention here, that basalt treated in the same manner, has the same property as the púzzolana: the whinstone, of which the ovoidal paving-stones consist mostly, is of this kind; and it is found in great abundance in these countries, in different forms.—B.

⁂ It may not be amiss to ascertain by experiment, whether the slag of the blacksmith's forge, which contains a considerable proportion of oxided iron, will not, with a due proportion of lime and sand, form a factitious puzzolana, equal to any we obtain from abroad. If this should be the case, as, from some few slight experiments I am disposed to believe, we shall always have, in every situation, ample materials for this important matter.—Coxe.

† Tilloch, vol. 34, p 178. From the *Annales de Chimie*, tome 64, p. 273.

It seems, therefore, an interesting subject to collect the various processes which have been employed for adapting different mineral substances to the uses of puzzolana, and with this view I have drawn up the present extract of M. Lepere's two memoirs, without binding myself to follow his order.

A substitute for puzzolana may be procured in three ways. 1st, By employing the remains of the extinguished volcanoes which almost all countries produce. 2dly, By substituting some other volcanic products for puzzolana. 3dly, By giving to certain mineral substances, by calcination, all the properties of these volcanic productions.

Messrs. Desmarets and Faujas Saint Fond long ago made known some strata of good puzzolana in the volcanoes of Auvergne and Vivarais. I also pointed out this substance in the volcanoes which separate Lodeve from Bedarieux, in the department of the Herault, and it has been employed with success in the construction of bridges and other hydraulic buildings.

We may also find a substitute for puzzolana in other volcanic products, such as basalt, pumice stones carefully pounded, &c.

In 1787 M. Guyton de Morveau sent to M. de Cessart, at Cherbourg, some calcined basalts from the extinguished volcano of Drevin, in the department of the Var and Loire. The latter proved by conclusive experiments, that they might be employed with great advantage in buildings under water.

The Dutch terrass is a kind of pumice stone brought from Bonn and Andernach. At Dordrecht, at the mouths of the Rhine and Meuse, the operation of pounding is effected.

But these resources are local; and as the manufacture of puzzolana may become general, we proceed to describe the best means of attaining it.

It would be difficult to assign the period at which pounded bricks and the earthy residue from the distillation of aquafortis were substituted for volcanic puzzolana. Their use, however, has become general, particularly where there are no sea-ports in the vicinity at which real puzzolana can be furnished: even in the south of France they prefer the earthy residue of the distillation of aquafortis to the best puzzolanas for coating the inside of the wine tubs, which are almost all of mason work, and for the cements used by individuals in hydraulic works. The earth employed in the south of France for the decomposition of saltpetre, by extracting the aquafortis from it, is an ochrey earth very much charged with iron, and more or less reddened by the oxide of this metal. When it is wanted for cement, it is only necessary to beat it up with lime and a proper quantity of water. M. Lepere relates some experiments made at Paris by the engineers of roads and bridges, from which it appears that an immersion of eight days was sufficient for aquafortis cements to acquire a hardness fit to resist a billet of wood when forced against it with the whole strength of a man; whereas the Italian puzzolana required six weeks before it attained the same degree of hardness.

In general the quality of the earth is better in proportion as it is charged with iron.

This last observation is equally applicable to pounded bricks: in general they do not make a good cement unless they are well burnt, and made of very ferruginous earth.

Twenty years ago I suggested the above substitutes for puzzolana; and the result of my comparative trials made in the port of Cette, under the inspection of the engineers of the province of Languedoc, was published in 1787, in a memoir printed by Didot, by order of the states-general of the province.

The means which I suggested for making this artificial puzzolana are simple, and may be put in practice almost every where. Balls should be made of the ochrey earth, and burned in a lime or potter's kiln. In order to form these balls, the earth must be moistened with a sufficient quantity of water; and when the balls are made, they should be burned until they pass from a red to a black colour, and the angles of the scales formed when they are broken exhibit sharp and shining edges.

In the same work I proposed to substitute the blackish schists which are decomposed in the air for puzzolanas. Those which are in cakes are best; but in all cases they must be strongly calcined, in order to give them the requisite properties.

M. Lepere relates that M. Vitalis, professor of chemistry and secretary to the Rouen Academy, and M. Lamassen, chief engineer of the department of the Lower Seine, have made most excellent puzzolana by the calcination of some ochrey earths in the environs of Rouen: this was effected by burning the earth in a common furnace with alternate strata of common charcoal. This puzzolana was subjected to some trials on a large scale, and it was composed in the following manner:

One part and a half of yellow calcined ochrey earth.

One part and three-fourths of well washed siliceous sand.

One part and an eighth of sour lime.

Two parts of chips from calcareous stone and silex.

From these and several other experiments (the proportions of which were varied) it results, that the artificial puzzolana constantly exhibited the same effects as the best puzzolana of Italy. M. Lepere was an eye-witness of all these comparative experiments.

There can be no doubt, therefore, that wherever there are ochrey earths, artificial puzzolana may be made with great facility.

What is called Dutch terrass is in many respects similar to the artificial puzzolana in question.

The ashes, or rather scoriæ, left when coals are burnt, may also be applied to the same purpose. M. Guyton caused a trial to be made at Cherbourg, and it succeeded well.

M. Gratien Lepere, having been intrusted in 1804 with constructing the foundation of the new arsenal at Cherbourg, began to turn his attention to the best method of supplying the puzzolana of Italy. He knew that the Swedes had already used a very hard black slate with this view, after being twice strongly calcined in a lime-kiln.

M. Lepere thought he perceived a great analogy between the Swedish stone and the rocks of Cherbourg, particularly those of port Bonaparte, which, when dug into, exhibited a black schistus, hard, ferruginous, and falling off in scales of various thickness: subsequent experiments, however, proved that the slaty schistus of Roule, in the environs of Cherbourg, is preferable, and that good mortar may be made with the ferruginous schist of Haineville, which is inferior, however, to the two former.

After having multiplied and varied his experiments in such a manner as to present positive results, M. Lepere, in conjunction with the committee of engineers appointed to examine his experiments, draws the following conclusions:

1st. That the schist of Cherbourg, when strongly calcined and pulverised, forms an excellent mortar when mixed with sour lime.

2dly. That in order to give precisely the same properties to schist which are possessed by puzzolana and terrass, the former must be calcined in a reverberating, instead of a lime, furnace.

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No. 50.

Description of a very simple and useful Scale, for dividing the vanishing Lines in Perspective. In a Letter from G. CUMBERLAND, *Esquire, to Mr.* NICHOLSON.*

(With an engraving.)

SIR—Having been in the habit of drawing for my amusement all my life, and feeling the value of that acquirement, it has been my practice to recommend to others as much of that acquisition as can with very little trouble be attained; I mean the putting into perspective common objects; such as simple landscapes, machines, buildings, and the interior of apartments, manufactories, &c. And where I have had an opportunity to give four or five close lessons, I have generally seen my end obtained to their great satisfaction, without ever showing them the *Jesuits*, or any other voluminous treatise; books that have hindered more the study of art, than they have ever made artists; for a moment's consideration on this subject will convince any mind, capable of reflection, that, to accomplish the general ends that even most painters have in view with respect to that art, it is only necessary to know the use of *the points of sight and horizontal line.* For while men have agreed to avoid bevel lines in all their constructions that are intended for use or habitation, we shall only want as much knowledge of the art as will enable us to put these into perspective, and to assist us at first, before, by practice, we have attained a correct eye; for practice, daily practice, will soon do all the rest, even by barely drawing the interior of a large apartment or gallery, with the objects continually before us in common use.

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* Nicholson, vol. 16, p. 1

To save time, however, and to imprint the few lessons necessary to be given on the mind of a learner, I have, some time back, made use of the following simple contrivance, which I now send to you, as the most likely means of universally promoting this necessary preliminary study, where the first general principles have been instilled:—Take a sheet of paper of an octavo size, and rule it with very black ink, from A to B (fig. 1, plate 7). This represents the horizontal line; then fix a point in the centre, at C; this we will call the moveable point of sight: afterwards cross it, as in the plate, with as many diagonal lines as you please; and thus you have an instrument prepared that will be a sure guide to an inexperienced eye, in taking the perspective lines of all objects placed at right angles; such as streets, buildings, churches, apartments, &c. by merely placing it under the leaf you mean to draw them on from nature, so as to see them faintly through, as boys do their writing-copies, when young and inexperienced.

But, to make this instrument more complete, we should add a plate of glass of the same size as the leaf of the drawing-book, on which the like dark lines should be drawn so as, by holding it up perpendicularly, we may see, and, as it were, render tangible, the truth of perspective lines of buildings; and for those whose sight is bad, or for very young people, it would not be amiss to take a copper-plate of the like dimensions, and with a fine needle gently scratch out the like lines, in which case there will be no necessity to take off the burrs, as the engravers, call the ridges raised in ploughing copper; and from this plate, *ten thousand* impressions may be taken of the faint lines by way of guide, on the drawing-book of a young beginner, without injuring the plate; for I can assure your readers, that it is more difficult to erase a slight scratch from a sharp needle on copper, by the act of taking impressions, than the deepest cut of the graver; the reason of which is, that the ridges of the skin of the printer's hand can never enter that fine line, whereas, in a coarse one, he polishes the edges of it down by every operation, and thus renders it a smooth channel, at last undefined, and incapable of retaining the printing ink; and the reason I am so diffuse on the subject is, that I think the knowledge of it may be generally useful, particularly to those who wish to extend the publication of botanical outlines: as it is not necessary to be taught the art of engraving for those who can draw lines, to design on copper the peculiarities of plants, or their anatomy. How to trace deeper lines with certainty on copper as easily as on paper, I will have the pleasure to communicate to you at my next leisure moment.

But, to return to our subject.

To this simple contrivance, we may add a sheet of perpendicular lines, by which means the uprights will all be shown; and for very heavy intellects, at first even the horizontal scale might be useful, though I never found it so among my acquaintance. There are also many little helps of simple contrivances to further the first acquirement of this plain branch of the art; that, if you approve the idea, I shall with pleasure transfer from my portfolio: but with respect to the application of this already described, it will be necessary to premise, that the scale should be longer than the drawing-book each way; by which means, by barely sliding it to the right or left, you can at pleasure place your point of sight more or less to the right, or left, or middle of the horizon; and, to be prepared for all circumstances, it would be as well to be provided also with a scale having a high horizon, and another with a very low one, such as the Dutch painters generally used, and which ever produces a picturesque effect, by giving many profiles of the elevations, and multiplying the lines of light.

Thus you have an easy expedient for a first help—practice will accomplish the rest; for we all know, or should know, that daily practice discloses to the industrious draftsman all the arcana of optical, aereal, and linear perspective, destitute, it is true, of terms to describe his acquirement; but to his own mind a perfectly intelligible and useful rule, by the help of which he can, with certainty, imitate all he sees on the theatre of the universe. I am, &c.

GEORGE CUMBERLAND.

Bristol, December 4, 1806.

NO. 51.

Description of a Cheap, Simple, and Portable Instrument, for determining the Positions of Objects in taking a Picture from the Life. By R. L. EDGEWORTH, *Esquire.*[*]

(With an engraving.)

THAT active and intelligent philosopher and journalist, citizen Pictet, author of the Bibliotheque Brittanique, on his late return from London to Paris, presented various instruments brought from this country to the National Institute of France. Among them was the instrument here to be described, and since published in the Bulletin des Sciences; on inspection of which my attention was excited to my notes, where, among other communications to be made to my readers, I find this instrument, as published in the excellent work "On Practical Education," by Maria Edgeworth and her father, to whom I have ascribed the contrivance in the title. The authors of the Bulletin affirm, that it was invented and executed by the children under the parental care of Miss Edgeworth; but I find no such intimation in the original work. The instrument of professor Pictet is in various respects inferior to that which I have here copied; insomuch that citizen Cloquet has proposed an amendment, for giving the index an horizontal position when it is required to transfer the observation to paper, which is in fact less effectual than the provisions made for that purpose, and for fixing the true instrument. After this preface, I shall proceed to copy without farther remark, page 460.

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[*] Nicholson, vol. 1, p. 281.

"An early use of a rule and pencil, and easy access to prints of machines, of architecture, and of implements of trades, are of obvious use in this part of education (mechanics). The machines published by the Society of Arts in London, the prints in Desaguliers, Emerson, le Spectacle de la Nature, Machines approuvées par l'Académie, Chambers's Dictionary, Berthoud sur l'Horlogerie, Dictionaire des Arts et des Metiers, may in succession, be put into the hands of children. The most simple should be first selected, and the pupils should be accustomed to attend minutely to one print before another is given to them. A proper person should carefully point out and explain to them the first prints that they examine; they may afterwards be left to themselves.

"To understand prints of machines, a previous knowledge of what is meant by an elevation, a profile, a section, a perspective view, and a (*vue d'oiseau*) bird's eye view, is necessary. To obtain distinct ideas of sections, a few models of common furniture, as chests of drawers, bellows, grates, &c. may be provided, and cut asunder in different directions. Children easily comprehend this part of drawing, and its uses, which may be pointed out in books of architecture; its application to the common business of life is so various and immediate, as to fix it for ever in the memory; besides, the habit of abstraction, which is acquired by drawing the sections of complicated architecture or machinery, is highly advantageous to the mind. The parts which we wish to express are concealed, and are suggested partly by the elevation or profile of the figure, and partly by the connection between the end proposed in the construction of the building, machine, &c. and the means which are adapted to effect it.

"A knowledge of perspective is to be acquired by an operation of the mind, directly opposite to what is necessary in delineating the sections of bodies; the mind must here be intent only upon the objects that are delineated upon the retina, exactly what we see; it must forget or suspend the knowledge it has acquired from experience, and must see with the eye of childhood no farther than the surface. Every person who is accustomed to draw in perspective, sees external nature, when he pleases, merely as a picture: this habit contributes much to form a taste for the fine arts; it may, however, be carried to excess. There are improvers who prefer the most dreary ruin to an elegant and convenient mansion, and who prefer a blasted stump to the glorious foliage of the oak.

"Perspective is not, however, recommended merely as a means of improving the taste, but as it is useful in facilitating the knowledge of mechanics. When once children are familiarly acquainted with perspective, and with the representations of machines by elevations, sections, &c. prints will supply them with an extensive variety of information; and when they see real machines, their structure and use will be easily comprehended. The noise, the seeming confusion, and the size of several machines, make it difficult to comprehend, and combine their various parts, without much time, and repeated examination; the reduced size of prints lays the whole at once before the eye, and tends to facilitate not only comprehension, but contrivance. Whoever can delineate progressively as he invents, saves much labour, much time, and the hazard of confusion. Various contrivances have been employed to facilitate drawing in perspective, as may be seen in "Cabinet de Servier, Memoirs of the French Academy, Philosophical Transactions, and lately in the Repertory of Arts." The following is simple, cheap, and portable.

"Plate 7, fig. 2, A, B, C, represent three mahogany boards, two, four, and six inches long, and of the same breadth respectively, so as to double in the manner represented. Fig. 3, the part A is screwed, or clamped to a table of a convenient height, and a sheet of paper, one edge of which is put under the piece A, will be held fast to the table. The index P is to be set (at pleasure) with its sharp point to any part of an object which the eye sees through E the eye-piece.

"The machine is now to be doubled as in Fig. 3, taking care that the index is not disturbed; the point, which was before perpendicular, will then approach the paper horizontally and the place to which it points on the paper must be marked with a pencil. The machine must be again unfolded, and another point of the object is to be ascertained in the same manner as before; the space between these points may be then connected with a line; fresh points should then be taken, marked with a pencil, and connected with a line; and so on successively till the whole object is delineated."

The above machine affords a delineation which is strictly accurate: but I take this opportunity of mentioning one still more portable, though less exact, which may be used in taking small sketches in the field; where the table, and fixed sheet of paper cannot always be supposed at hand. I do not know the contriver. It is merely a strait flat ruler, having a division of inches and small parts (or any other division) on its edge. A string is fastened to the middle of the ruler by passing it through a hole, and tying a knot on the other side; and at the other end of the string there is a small bead or knot to be held in the mouth. The length of the string may be adjusted at pleasure; and when the ruler is used, it is held up at right angles to the stretched string, so that its edge, as seen by one eye, may apply to any two objects; between which it will show the distance to be afterwards transferred upon the paper by a scale, or by estimate.

In this use of a graduated rule, it is most convenient and accurate to select some one object in the picture for the point of sight, and to measure all the distances from thence from the middle or beginning of the divisions where the direction of the sight is at right angles to the rule. And as this simple instrument does not give the inclinations, it may be best always to measure parallel or perpendicular to the horizon, and estimate the rest. Indeed, the contrivance must be considered only as a substitute for the usual method of estimating, and may be principally useful to assist in acquiring a correct judgment in this respect.

WILLIAM NICHOLSON.

NO. 52.

A simple and accurate Method of Surveying on Shore, with such Instruments only as are in every one's Possession. By Captain JOHN MORTLOCK.*

(With an engraving.)

SIR—Almost all our treatises on nautical surveying begin with the explanation and description of what are called the necessary instruments, which are described so numerous, and the price so considerable, that very few can procure them: Thus discouraged, they abandon every idea of making plans of such ports as they touch at, for want of what they conceive to be the necessary instruments.

To obviate this difficulty, and to render nautical surveying more general, I have, in the annexed paper, attempted to shew the mariner how to survey any port or place he may touch at, with great accuracy, little trouble, and without any expense for instruments. Should you find this simple method deserving of a place in your valuable Journal, I shall feel myself honoured by your inserting it. I am, &c.

J. MORTLOCK.

To Mr. NICHOLSON.
January 7, 1805.

FIRST make an eye-sketch of the place to be surveyed, as the annexed figure, numbering all the points, bays, rocks, shoals, &c. Choose two stations, as A and B, (fig. 4, plate 7,) whence all the rocks, points, &c. may be seen from, and so situated from each other, that the bearings of the points, &c. as taken from A and B, shall intersect at angles at least greater than ten degrees, but the nearer ninety degrees the better.

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* Nicholson, vol. 10, p, 103.

Having chosen the stations, proceed to one of them as A, and place the paper intended to receive the plan horizontally before you, extended by pins, or otherwise, on a board securely fixed, to prevent it shifting its position while the bearings are drawing.

Stick a pin through the paper firm into the board, at the part meant to represent the station A, and lay a ruler with a perfect straight edge on the paper, touching the pin at A and pointing towards the station B, and draw the line AB: in like manner draw lines from A towards all the points, rocks, bays, &c. numbering the lines as the points, rocks, bays, &c. are numbered in the eye-sketch: Proceed next to the station B, and place the board horizontally before you, so that the line AB shall point back towards A, and secure the board with the same precaution as at A, to prevent its shifting: then, in the line AB, stick a pin firm through the paper into the board, in that part meant to represent the station B; from which point draw lines pointing towards the different points, rocks, &c. as was done from A, numbering them in like manner. Now, where the lines drawn from B intersect those of the same number drawn from A, will be the place of the points, rocks, &c. to which the lines were directed to from the stations. Sketch in the shore between the points, &c. and the plan is completed.

The meridian-line may be found by compass, or more correctly, by drawing the line of the sun's bearing from one of the stations, and taking his altitude at the same time. Then with the latitude, altitude, and declination, compute the azimuth, and lay it off to the left or right of the line of the sun's bearing, according as the sun was to the right or left of the meridian, and it will give the true north and south, or meridian-line.

If the distance between any two points on the shore be measured, it will give you a scale for the plan; but it may often be found more convenient to measure off a base, as AC, from one of the stations, in a direction nearly perpendicular to the line AB; and let it be in length equal to some part of a geographical mile, as 380 feet = $\frac{1}{16}$, or 760 = $\frac{1}{8}$, or 1520 = $\frac{1}{4}$ or 3040 = $\frac{1}{2}$, or any part of a mile; then will the line AC be a scale to the plan.

I have supposed any common board and ruler to illustrate the simplicity of this method of surveying: but to such as are provided with a drawing frame, it will be found convenient to extend the paper on; and if a ruler has sights perpendicular to its edge, it will be found commodious, and require less trouble. I hope the ease and expedition with which the whole is performed, will induce sea-faring people to amuse themselves by taking plans of the places they touch at: for it is by the improvement of geography that the dangers of navigation are diminished, and, consequently the lives and property embarked in our shipping are less exposed to danger.

No. 53.

Description of a simple Instrument for making correct Drawings from Nature. By T. C. B.*

(With an engraving.)

SIR—The description of two instruments for facilitating landscape drawing from nature given in the first volume, page 281, of your Journal,† has suggested to me the construction of another, which seems to unite the accuracy of the first of those instruments with the simplicity and portability of the second. As I conceive it may be they may be discerned in this manner sufficiently well for determining the principal positions.

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* Nicholson, vol. 10, p. 111.

† See p. 258 of this volume of the Emporium.

The pencil, however, and any object, which it is to trace, cannot both be seen distinctly in the same state of the eye, on account of the difference of their distances, and the efforts of successive adaption of the eye to one or to the other, would become painful if frequently repeated. In order to remedy this inconvenience, the paper and pencil may be viewed through a convex lens of such a focus, as to require no more effort than is necessary for seeing the distant objects distinctly. These will then appear to correspond with the paper in *distance* as well as *direction*, and may be drawn with facility, and with any desired degree of precision.

This arrangement of glasses will probably be best understood from inspection of fig. 1, *a b* in the transparent glass; *b c* the lower reflector; *b d* a convex lens (of twelve inches focus) *e* the position of the eye; and *f g h e* the course of the rays. See plate 8.

In some cases a different construction will be preferable. Those eyes, which without assistance are adapted to seeing near objects alone, will not admit of the use of a convex glass; but will on the contrary require one that is concave to be placed in front, to render the distant objects distinct. The frame for a glass of this construction is represented at *i k*, (fig. 3,) turning upon the same hinge at *h* with a convex glass in the frame *l m*, and moving in such a manner, that either of the glasses may be turned alone into its place, as may be necessary to suit an eye that is long or short sighted. Those persons, however, whose sight is nearly perfect, may at pleasure use either of the glasses.

The instrument represented in that figure differs moreover in other respects from the foregoing, which I have chosen to describe first, because the action of the reflecrs there employed would be more generally understood. ut those who are conversant with the science of optics ill perceive the advantage that may be derived in this stance from prismatic reflection; for when a ray of light as entered a solid piece of glass, and falls from within pon any surface, at an inclination of only twenty-two or wenty-three degrees, as above supposed, the refractive ower of the glass is such as to suffer none of that light pass out, and the surface becomes in this case the most rilliant reflector that can be employed.

Fig. 2, represents the section of a solid prismatic piece f glass, within which both the reflections requisite are ffected at the surfaces *a b*, *b c*, in such a manner that he ray *f g*, after being reflected first at *g*, and again at , arrives at the eye in a direction *h e* at right angles to *f g*.

There is another circumstance in this construction necessary to be attended to, and which remains to be explained. Where the reflection was produced by a piece of plain glass, it is obvious that any objects behind the glass (if sufficiently illuminated) might be seen through the glass as well as the reflected image. But when the prismatic reflector is employed, since no light can be transmitted directly through it, the eye must be so placed that only a part of its pupil may be intercepted by the edge of the prism, as at *e*, fig. 2. The distant objects will then be seen by this portion of the eye, while the paper and pencil are seen past the edge of the prism by the remainder of the pupil.

In order to avoid inconvenience that might arise from unintentional motion of the eye, the relative quantities of light to be received from the object, and from the paper are regulated by a small hole in a piece of brass, which by moving on a centre at *c*, fig. 3, is capable of adjustment to every inequality of light that is likely to occur.

Since the size of the whole instrument, from being so near the eye, does not require to be large, I have on many accounts preferred the smallest size that could be executed with correctness, and have had it constructed on such a scale, that the lenses are only three quarters of an inch in diameter.

Though the original design, and principal use of this instrument is to facilitate the delineation of objects in true perspective, yet this is by no means the sole purpose to which it is adapted; for the same arrangement of reflectors may be employed with equal advantage for copying what has been already drawn, and may thus assist a learner in acquiring at least a correct outline of any subject.

For this purpose the drawing to be copied should be placed as nearly as may be at the same distance before the instrument that the paper is beneath the eyehole, for in that case the size will be the same, and no lens will be necessary either to the object, or to the pencil.

By a proper use of the same instrument, every purpose of the pentagraph may also be answered, as a painting may be reduced in any proportion required, by placing it at a distance in due proportion greater than that of the paper from the instrument. In this case a lens becomes requisite for enabling the eye to see at two unequal distances with equal distinctness, and in order that one lens may suit for all these purposes, there is an advantage in carrying the height of the stand according to the proportion in which the reduction is to be effected.

The principles on which the height of the stem is adjusted will be readily understood by those who are accustomed to optical considerations. For as in taking a perspective view the rays from the paper are rendered *parallel,* by placing a lens at the distance of its *principal* focus from the paper, because the rays received from the distant objects are *parallel;* so also when the object seen by reflection is at so short a distance that the rays received from it are in a certain degree *divergent,* the rays from the paper should be made to have the same degree of divergency in order that the paper may be seen distinctly by the same eye; and for this purpose the lens must be placed at a distance less than its principal focus. The stem of the instrument is accordingly marked at certain distances to which the conjugate foci are in the several proportions of 2, 3, 4, &c. to 1, so that distinct vision may be obtained in all cases, by placing the painting proportionally more distant.

By transposing the convex lens to the front of the instrument and reversing the proportional distances, the artist might also enlarge his smaller sketches with every desirable degree of correctness, and the naturalist might delineate minute objects in any degree magnified.

Since the primary intention of this instrument is already, in some measure, answered by the *Camera Obscura,* a comparison will naturally be made between them.

The objections to the Camera Obscura are

1st. That it is too large to be carried about with convenience.

The Camera Lucida is as small and portable as can be wished.

2dly. In the former, all objects that are not situated near the centre of view are more or less distorted.

In this, there is no distortion; so that every line, even the most remote from the centre of view, is as strait as those through the centre.

3dly. In that, the field of view does not extend beyond thirty degrees, or at most thirty-five degrees, with distinctness.

But in the *Camera Lucida* as much as seventy or eighty degrees might be included in one view.

NO. 55.

Method of preparing Pannels for Painters. By Mr. S. GRANDI.*

TAKE the bones of sheep's trotters, break them grossly, and boil them in water until cleared from their grease, then put them into a crucible, calcine them, and afterwards grind them to powder. Take some wheaten flour, put it in a pan over a slow fire until it is dry, then make it into a thin paste, add an equal quantity of the powdered bone-ash, and grind the whole mass well together: this mixture forms the ground for the pannel.

The pannel having been previously pumiced, some of the mixture above-mentioned is rubbed well thereon with a pumice-stone, to incorporate it with the pannel. Another coat of the composition is then applied with a brush upon the pannel, and suffered to dry, and the surface afterwards rubbed over with sand-paper.

A thin coat of the composition is then applied with a brush, and if a coloured ground is wanted, one or two coats of the colour is added, so as to complete the absorbent ground.

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* Nicholson, vol. 16, p. 316.—The processes of Mr. Grandi being founded upon practice, were supported to the Society of Arts, by certificates from our most eminent painters; in consequence of which, and of the exhibition of the pannels, the Society awarded him the silver medal and twenty guineas.

When it is necessary to paint upon a pannel thus prepared, it must be rubbed over with a coat of raw linseed or poppy-oil, as drying oil would destroy the absorbent quality of the ground; and the painter's colours should be mixed up with the purified oil hereafter mentioned.

Canvass grounds are prepared, by giving them a thin coat of the composition, afterwards drying and pumicing them, then giving them a second coat, and, lastly, a coat of colouring matter along with the composition.

The grounds thus prepared do not crack; they may be painted on a very short time after being laid, and from their absorbent quality, allow the business to be proceeded upon with greater facility and better effect than with those prepared in the usual mode.

Method of purifying Oil for Painting.

MAKE some of the bone-ashes into a paste with a little water, so as to form a mass or ball; put this ball into the fire, and make it red hot; then immerse it for an hour, in a quantity of raw linseed oil, sufficient to cover it: when cold, pour the oil into bottles, add to it a little bone-ash, let it stand to settle, and in a day it will be clear and fit for use.

White Colour is made by calcining the bone of sheep's trotters in a clear open fire, till they become a perfect white, which will never change.

Brown Colour is made from bones in a similar manner, only calcining them in a crucible instead of an open fire.

Yellow Colour, or Masticot. Take a piece of soft brick, of a yellowish colour, and burn it in the fire; then take for every pound of brick, a quarter of a pound of flake white, grind them together and calcine them; afterwards wash the mixture, to separate the sand,—and let the finer part gradually dry for use.

Red Colour, equal to Indian-Red. Take some of the pyrites, usually found in coal-pits, calcine them, and they will produce a beautiful red.

Grey Colour is made by calcining together blue-slate and bone-ashes powdered, grinding them together, afterwards washing them, and drying the mixture gradually.

Blue-Black is made by burning vine-stalks in a close crucible in a slow fire, till a perfect charcoal is made of them, which must be well ground for use.

Crayons are made of bone-ash powder mixed with spermaceti, adding thereto the colouring matters. The proper proportion is, three ounces of spermaceti to one pound of the powder. The spermaceti to be first diffused in a pint of boiling water, then the white bone-ash added, and the whole to be well ground together, with as much of the colouring matter as may be necessary for the shade of colour wanted. They are then to be rolled up in the proper form, and gradually dried upon a board.

White Chalk, if required to work soft, is made by adding a quarter of a pound of whitening to one pound of the bone-ash powder will answer alone. The coloured chalks are made by grinding the colouring matter with bone-ashes.

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NO. 56.

Account of the Method of Obtaining Patents. By Dr. WILLIAM THORNTON.

HAVING been requested by several persons to point out, in the Emporium, the mode to be pursued in obtaining a patent right from the United States, I have thought it most advisable to publish at length the necessary proceedings, as detailed in a small pamphlet by Dr. Thornton, of the Patent Office, which contains every information on this subject.

EDITOR.

Patent Office, March 5, 1811.

HAVING the honour of directing or superintending the important duties of issuing patents for arts and inventions, which were formerly thought worthy of the labours of a council composed of the Secretary of State, the Secretary of War, and the Attorney General of the United States, I have thought it a duty to my fellow citizens to publish a few lines of information to facilitate the mode of acquiring patents, by which many will be enabled to dispense with long journies to the seat of government, or with troubling their friends with a tedious correspondence.

Viewing with astonishment the inventions of my countrymen, I cannot contemplate them without being impressed with the idea, that no nation on earth surpasses them in genius. Even the unlettered inhabitants of the forest have perfected inventions that would have done honour to Archimedes; and I reproach myself for not having published long ago a few directions how to proceed in securing the advantages of the efforts of their talents. This information would have been given, but I anxiously waited the proposed revision of the patent law, which has been under the consideration of the honourable the congress for seven years; and, if I delay this short sketch any longer, I fear it may be said,—

> He who defers his work from day to day,
> Does on a river's bank expecting stay
> 'Till the whole stream, which stops him, should be gone;
> But, as it runs, forever 'twill run on.

Before an application be made for a patent, I would advise the inventor to examine well the Dictionaries of the Arts and Sciences, the Repertory of the Arts, and other publications that treat of the mechanic arts, to endeavour to ascertain if the invention be new; also to make inquiry of scientific characters, whether or not the invention or discovery be practicable. These previous inquiries will sometimes prevent great trouble, and save the expense of much time, labour, and money; for a patent does not confer rights where just claims do not exist; and, as there is at present no discretionary power to refuse a patent, even where no just claim exists, it may be proper to caution the purchaser of patent rights against the supposition, that the invention patented is always valuable, or new, or that it interferes with no previous patent. The respectable names of the President, the Secretary of State, and the Attorney General, are requisite to give validity to a patent; but ought never to be considered, in any degree, as an evidence of the originality or utility of the invention. The issuing of patents is grounded not only on a desire to promote the progress of useful arts, but also to prevent the loss of valuable secrets; for many have been buried with the inventors, previous to the organization of this system of protection for the property of talent, mind, and genius. Formerly the arcana of any profession were withheld from the Tyro; his initiation was gradual and secret; and the caution with which inventors worked, to prevent the infringement of unprotected rights, confined many important inventions to limits too narrow to materially benefit either the inventors or the world; at present the law grants a monopoly to the inventor, for a limited time, provided the art, invention, discovery, or machine be duly explained, deposited, and recorded, for the benefit of mankind, as soon as the time limited has expired; and the patent is not only an evidence that the inventor has formally confided his secret to the public, but also a declaration of the protection of the right from infringement; nevertheless of the infringement of the right, by others, a jury of the country is only competent to decide.

The general law, concerning the issuing of patents, will be found in the second volume of the Laws of the United States, page 200. This law provides for citizens only; but a subsequent law (vol. 5, page 88) provides also for applicants who have resided two years, or upwards, in the United States, and who are not citizens.

In applying for a patent it is necessary to attend to every legal form; for, in consequence of inattention to forms only, some of the patents issued formerly, have, in the courts of law, been declared to be null and void.*

Mode of Application.

"Every inventor, before he presents his petition to the Secretary of State, signifying his desire of obtaining a patent, shall pay into the treasury of the United States thirty dollars,† for which he will be furnished with duplicate receipts, one of which he shall deliver to the Secretary of State when he presents his petition; and the money, thus paid, shall be in full for the sundry services to be performed in the office of the Secretary of State, consequent to such petition."‡ This petition must be addressed to the Secretary of State, and may be in the following, or in a similar style:

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* Oliver Evans's, among the number.

† Notes of any of the banks of the United States

‡ See Laws of the United States, vol. 2, chap. xi, § 11, p. 203.

TO THE HONOURABLE JAMES MONROE, SECRETARY OF STATE OF THE UNITED STATES:

The petition of A. B. of ——— in the county of ——— and state of ——— respectfully represents:

THAT your petitioner has invented a new and useful improvement [" or art, machine, manufacture, or composition of matter, or any new and useful improvement in any art, machine, manufacture, or composition of matter] in ——— not known or used before his application," the advantages of which he is desirous of securing to himself and his legal representatives: he therefore prays that letters patent of the United States may be issued, granting unto your petitioner, his heirs, administrators, or assigns, the full and exclusive right of making, constructing, using, and vending to others to be used, his said improvement, [art, invention, machine, manufacture, or composition of matter, &c.] agreeably to the acts of Congress in such case made and provided; your petitioner having paid thirty dollars into the treasury of the United States, and complied with the other provisions of the said acts.

A. B.

The *specification* or description of the machine, art, discovery, or invention, must be given in clear and specific terms, designating it from all other inventions, and describing the whole in such a manner as to comprehend not only the form and construction, if a machine, but also the mode of using the same; and if it be only an improvement on a certain machine already invented by the applicant or any other, it ought to be so mentioned or described; and as this specification, description, or schedule, enters into and forms part of the patent, it must be without any references to a model or drawing, and must be signed by the applicant, or applicants, before two witnesses. It is material that this be in good language, and correctly written, as it is transcribed into the patent, and the original papers will be deposited in an office that will hand them down to posterity, by which the honour of the country is concerned in this attention. The modest inventor will no doubt exclude those panegyrics on the excellence of his invention or discovery, which abound sometimes in the productions of the inferior genius, but which ought not to enter into the patent.

The following, or a similar oath or affirmation, taken [before a judge of any of the courts, or a justice of the peace, or any person qualified to administer an oath] by the applicant, or applicants, must be subjoined to the specification, if citizens of the United States.

Form.

County of —— } *ss.*
State of —— }

On this — of ——, 18—, before the subscriber, a justice of the peace, in and for the county aforesaid, personally appeared the above named A B, and made solemn oath [or affirmation] according to law, that he verily believes himself to be the true and original inventor or discoverer of the art [machine, invention, or improvement, composition of matter, &c.] above specified and described, for ——— (mention here the object or intention) —— and that he is a citizen of the United States.

———, J. P.

If not a citizen (or citizens) the following addition must be made to the declaration, that he verily believes himself to be the true and original inventor or discoverer of the art, &c.

"And that the same hath not, to the best of his or her knowledge or belief, been known or used either in this or

any foreign country.————————————"*
Also, that he (or she) hath resided in the United States two years and upwards.———

————J. P.

THE specification must be accompanied by a good drawing, in perspective, of the whole machine or apparatus, "where the nature of the case admits of drawings; or with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention is of a composition of matter. And such inventor shall, moreover, deliver a model of his machine, provided the Secretary shall deem such model to be necessary."† It is requisite, in giving a drawing of the machine, to give also sectional drawings of the interior, when the machine is complex: and every drawing should be accompanied with explanatory references. When a machine is complex, a model will likewise be necessary, not only to explain and render it comprehensible to a common capacity, but also to prevent infringements of rights; for many will plead ignorance of drawings, who cannot avoid the conviction of wheels and pinions.

The drawings ought not to exceed a quarto size, and if confined to octavo they would be still better, where it can be done conveniently and distinctly.

Many of the drawings in this office are executed in a very handsome style, and do much credit to the talents of the gentlemen whose names are ascertained. If the artists would always sign them, information might be given to the applicants for patents where to apply for drawings.

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* Laws of the United States, vol. 5, chap. xxv, p. 89.

† Ibid, vol. 2, chap. xi, p. 292.

Among the best I have received, I notice the names of Messrs. James Aiken, Philadelphia; John Bernard, Utica, Oneida County, New York; Jacob Cist, P. M. Wilkesbarre, Pennsylvania; Francis Guy, Baltimore; George Hadfield, Washington city; Philip Hooker, Albany, New York; Nicholas King, Washington city; —— Peckham, Roxbury, Massachusetts; John R. Penniman, Boston; Abner Reed, Connecticut; Archibald Robertson, No. 78, Liberty street, New York; John F. Somerby, Catskill, New York; —— Steward, Hartford, Connecticut; John Stickney, Baltimore; —— Stiles, Worcester, Massachusetts; William Stickfand, Philadelphia; James Watson and John Watts, Utica, Oneida County, New York.

Many being without the names of the artists, I cannot do all the justice I wish.

The papers must all be sent under cover to the Secretary of State, which of course renders them free of postage: but if models be sent, their freight or carriage hither must be paid; and before packing them the name or names of the inventor or inventors should be written thereon, with the name of the machine and the date; for sometimes on receiving them it is difficult to know to whom they appertain.

The congress, being impressed with a high sense of the value of the inventions of our citizens, have purchased an elegant and extensive building, wherein preparations are now making for the accommodation of a very numerous collection of the machines, illustrative of the ingenuity displayed; and this museum of the arts, it is presumed, will stimulate the ingenious to send the models of their machines and inventions in a style that will rather honour than discredit our country.

Copy-rights of books, prints, charts, maps, &c. are secured "by depositing, before publication, a printed copy of the title of such map, chart, book or books, in the clerk's office of the district court, where the author or proprietor shall reside, who will record the same; and the author or proprietor shall, within two months from the date of the record, cause a copy of the said record to be published in one or more of the newspapers printed in the United States, for the space of four weeks.* And within six months after publishing the map, chart, book or books, the author or proprietor shall deliver, or cause to be delivered to the Secretary of State, a copy of the same; and when deposited and entered in the patent office, a certificate will be returned of its being received."† This will secure the sole right of publication for fourteen years to the author or proprietor, if a citizen of the United States, or resident therein.‡ "And if at the expiration of the said term, the author or authors, or proprietors, or any of them, be living, and a citizen or citizens of these United States, or residents therein, the same exclusive right shall be continued to him or them, his or their executors, administrators, or assigns, for the further term of fourteen years: *Provided* he or they shall cause the title thereof to be a second time recorded, and published in the above manner, within six months before the expiration of the first term of fourteen years aforesaid."

WILLIAM THORNTON.

In order to complete this account of the method of obtaining a patent, the Editor has given, in the next page, a copy of the letters patent.

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* See an act for the encouragement of learning, &c.—Laws of the United States, vol. 1, chap. 15, § 3, p. 121.

† Ibid, Sec. 4, p. 122.

‡ Ibid, Sec. 1, p. 118, 119.

No. 56.

Description of an Improvement in the Common Bedstead, by JOHN REDMAN COXE, *with a Copy of the Letters Patent, granted for the same.*

(With an engraving.)

THE United States of America, to all to whom these letters patent shall come:

Whereas John Redman Coxe, a citizen of the United States, hath alleged that he has invented a new and useful improvement in the construction of bedsteads, which improvement he states has not been known or used before his application; has made oath that he does verily believe that he is the true inventor or discoverer of the said improvement, has paid into the treasury of the United States, the sum of thirty dollars, delivered a receipt for the same, and presented a petition to the Secretary of State, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are therefore to grant, according to law, to the said John Redman Coxe, his heirs, administrators, or assigns, for the term of fourteen years, from the sixteenth day of October, 1812, the full and exclusive right and liberty of making, constructing, using and vending to others to be used, the said improvement; a description whereof is given in the words of the said John Redman Coxe himself, in the schedule hereto annexed, and is made a part of these presents.

In testimony whereof I have caused these letters to be made patent, and the seal of the United States to be hereunto affixed.

Given under my hand, at the city of Washington, this sixteenth day of October, in the year of our Lord, one thousand eight hundred and twelve; and of the independence of the United States of America, the thirty seventh.

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SEAL.
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JAMES MADISON.

By the President.

JAMES MONROE,
Secretary of State.

City of Washington, to wit:

I DO hereby certify, that the foregoing letters patent, were delivered to me on the sixteenth day of October, in the year of our Lord, one thousand eight hundred and twelve, to be examined; that I have examined the same, and find them conformable to law: and I do hereby return the same to the Secretary of State, within fifteen days from the date aforesaid, to wit: On this sixteenth day of October, in the year aforesaid.

WILLIAM PINKNEY,
Attorney General of the United States.

THE SCHEDULE referred to in these *letters patent*, and making part of the same, containing a description in the words of the said John Redman Coxe himself, of his improvement in the construction of bedsteads.

A SOURCE of trouble, not unfrequent in domestic life, is derived from the present construction of our bedsteads: the necessity of occasionally separating and replacing their parts, by the inattention or ignorance of the persons employed, soon proves destructive to the firmness and solidity of the joints, and gives an harbour to the most disagreeable of companions, the common bed bug.

Before I describe the improvements in the bedstead, which I think I have made, I shall concisely state some of the inconveniences and imperfections of the present construction.

These are,—

1st, The employment of screws, which pass through the posts, and deep into the rail, to penetrate the nut; together with the interior mortice in the post for the reception of the tenon cut on the rail. The screws are generally badly made of defective iron; and the heads are so soft, as to be speedily worn down by the action of the screw driver; and, by the misplacement of the screw, the nut is often loosened, and rendered of little importance to the firmness of the parts connected.

2nd, From the above sources, as well as from the usual roughness in the finish of the holes, the mortices, and the tenons; the bed bug, as above mentioned, readily makes a lodgment; which leads, of consequence, to the frequent use of hot water, lye, corrosive sublimate, and other domestic applications, too often, alas, incompetent to their complete destruction!

3rd, By such frequent ablutions, the parts are injured by swelling, the nuts are rusted, and the bedstead is often more closely kept together by the tightness of the sacking, than by the screws, &c. intended for this purpose.

4th, The head-board is now fixed firmly in the posts, and for its removal the complete separation of the bedstead becomes necessary. The difficulty of this, and of replacing the parts accurately, except to a professed joiner, will be admitted; especially as it is generally left to a careless and inexperienced domestic, to the almost necessary destruction of the bedstead in a short time.

By the plan I am about to describe, many, if not all, of the above difficulties are obviated, since the most stupid and inexperienced can scarcely fail of taking a bedstead apart and replacing it, as accurately as the best workman.

The post and rails are here completely solid,—no holes, no screws or nuts, no tenons or mortices, are found in the bedstead. The rails come flush against the posts, and the tenon and mortice are supplied by a small bolt beneath the rail, which shoots into the post about half an inch. The smoothness of the surfaces is a powerful obstacle to a secure lodgment of the bed bug or its eggs, and this part may be even still further secured, if necessary, by a coat of paint. The bolt is sunk into the wood to its level, and a brass cap may be sunk into the post for the bolt to shoot in, with even more accuracy than into the wood.

To the outside of the rail, (which is usually about four inches wide,) where it meets the post, is firmly screwed a brass hinge three inches in breadth, and sunk into the wood to its level, leaving half an inch of the rail visible above and below. The joint of this hinge, not being exactly central, falls within the edge of the rail, whilst the other portion crosses its junction with the post, into which it is accurately sunk likewise to its level. This moveable part of the hinge has two oblong openings or eyes, near its extremity, to receive two corresponding catches from a plate beneath; and behind these catches a wedge-like key falls down, and firmly fastens the post and rail. The edge of the hinge on this side is raised nearly to a level with the projecting catches, in form of a wedge or inclined plane, interiorly, the broadest part below, so as to prevent the key from slipping out sideways; and serving to increase the power of the key, since they resemble two wedges acting against each other.

The plate, to which these catches are attached, is sunk into the post below the lower level of the hinge, and is there firmly screwed on a level with the wood beneath. The whole of this plate, with the catches, will probably be better constructed of steel than of brass, since an equal strength will thereby be obtained, with a far inferior thickness.

It is evident, that the common low-post bedstead may be connected by the present plan; or the head and foot rail may still be joined permanently to the posts, leaving the side rails to be attached by the hinge and bolt.

The head board is fixed, in my plan, to the posts either by a small moulding attached to them firmly, with a flat posterior surface, against which the front edge of the board rests, and which prevents its escaping forwards; whilst behind, the board is provided on each side, above and below, with a small bolt sunk into it on a level, and which shoots into a corresponding hole in the post. Or a small catch, formed like the one half of the catch and plate described above, is fixed into the head board, in the places of the bolts, and fall down into a notch cut into a small piece of brass, which is permanently fastened into the posts. In either case, it is clear, that it may be immediately removed from the bedstead, and that its attachment is perfectly adequate to every intention of this part.

It is equally evident from this description, that nothing more is required to take down this bedstead than merely to draw back the bolts beneath the rails, to pull out the key from the hinges and to turn them back, when the whole is at once separated; the affixing the parts together is equally simple.

By this improvement, I claim every mode of junction in a bedstead formed upon the principle of any union of catches, bolts, or hinges, or of either separately:—of any connection by a common hook and eye, connected with bolts, &c. or by the dining-table staple-fastenings, &c. of which last my first attempt consisted, and which I find to answer perfectly well.

JOHN REDMAN COXE.

Witnesses. { LEWIS WALKER,
ANDREW PETTIT.

Reference to the Engraving. Plate 9.

Fig. 1. A bedstead in perspective, exhibiting the general connection of the parts by hinges and bolts.

a a a a, the bolts beneath the rails, shooting into the posts.

Fig. 2. The hinge separate from the bedstead. *a*, the part which is firmly screwed into the rail. *b*, the dotted line, shows the relative situation of the joining of the post and rail, which is not immediately beneath the joint of the hinge. *cc*, the two oblong holes of the hinge, through which the catches pass, that retain the key, or wedge, in its place. *d*, the edge of the hinge, on a level with the elevation of the key, and which, by its angular form, increases its wedgelike action.

Fig. 3. The plate which is permanently let in and screwed to the post beneath the hinge. *e*, *e*, the projecting catches of the plate, which pass through the oblong openings of the hinge *cc*, fig. 2, and behind which catches, the key falls down anterior to the hinge.

Fig. 4. The wedgelike key that falls behind the catches. This may be attached by a small chain to the post.

Fig. 5. The hinge, when keyed.

Fig. 6. A small piece of brass, with a notch, screwed into the post; into which notch, a catch on the headboard, similar to one of those above mentioned, *e*, fig. 3, falls, and thus attaches it firmly: Four of these are necessary; or four small bolts, fixed in the headboard, may be employed in their place, to shoot into the posts.

N. B. The plates may be screwed to the bedstead by screws of a proper size, and having their heads made *blue* by the action of heat. This gives an additional ornament to the brass plates. The plates themselves may be likewise rendered highly ornamental by fret work, or by bronzed figures, as lions' heads, &c. attached to them. It is proposed to apply a similar contrivance to connect the sides and bottoms of sophas, which will add to their beauty, and render them capable of being taken apart, as a bedstead. A bedstead on the above plan may be seen at Mr. Thomas's, cabinet maker, in fifth street, below Walnut.

NO. 58.

An Experiment on Soap-Suds as a Manure. By Mr. GEORGE IRWIN; *with Remarks by the Reverend* THOMAS FALCONER.*

A FEW years ago my attention was attracted by the soil of a garden, reduced to a state of poverty very unfriendly to vegetation. Interest in its future produce influenced my wishes for its restoration. An invigorating manure was necessary; but such a stimulus could not be easily procured. While considering which of the succedanea within my reach had the greatest probable appearance of succeeding, it occurred, that possibly some trivial advantage might be derived from the oil and alkali suspended in the waters of a washing.† Pits were immediately ordered to be made, and in them the contents of a tub, which my servant usually committed to the common sewer, were carefully deposited: as washing succeeded washing, other pits were dug and filled; so that the whole garden, a small portion only excepted, has in this manner been watered and enriched: that small portion remains a visible demonstration of the utility of this manure. There vegetation is still languid; while the residue of the garden, invigorated by the suds only, annually exhibits a luxuriance almost equal to any thing this fertile neighbourhood can produce. I am, &c.

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* Nicholson, vol. 20, p. 99. From *Papers of the Bath and West of England Society*, vol. 11, p. 261.

† It is the common practice of some parts, at least, of the west of England, to use a lixivium, made by passing water through an appropriate strainer containing wood ashes, for the purpose of washing. This was probably the case here, though not mentioned by the author.

GEORGE IRWIN.

Remarks by the Reverend THOMAS FALCONER.

1. The above important experiment may perhaps remind the reader of the principal ingredients of the oil compost, suggested by Dr. Hunter of York. In the simple fluid manure we have an animal oil, potash, and water; in the compost are the same oil and the same alkali, but neither of them, perhaps, in so pure a state as in the manure, with the addition of "fresh horse-dung." The fresh horse-dung is added, in order to produce "heat and fermentation; and a delay of "six months" is supposed to be necessary, to make the compost "fit for use." All, however, that seems to be gained by the horse-dung, is the animal oil, which may be united to the alkali during the process of fermentation, and the straw, which in the fermentation of the compost will bind the mass together, and when decomposed on the ground will afford a small supply of vegetable matter. If we make the comparison strictly accurate on the other side, we may observe, that in the fluid manure there must be an increased quantity of animal matter in the water, after it has been used for the purpose of washing linen.

The experiment then shows what is the advantage of the application of the oil and alkali only, as a manure, and perhaps the delay of "six months" in preparing the compost would not be compensated by any superior efficacy, that may be expected to arise from the combination of the horse-dung.

It also appears from the experiment, that the compost is a more useful discovery than Dr. Hunter himself could justly infer from his own limited experience of its effects.

2. This mixture of an oil and an alkali has been more generally known than adopted, as a remedy against the insects which infest wall-fruit trees. It will dislodge and destroy the insects, which have already formed their nests and bred among the leaves. When used in the early part of the year, it seems to prevent the insects from settling upon them; but whether by rendering the surface of the leaf disagreeable to the bodies of the animals, and thus repelling them, or by neutralizing the acid they deposit, and thus preventing the leaf from contracting into a necessary form for their reception, I cannot presume to determine. One of the modes, by which this mixture indirectly contributes to the fertility of the ground, may be by its destruction of the insects, which prey upon the plants.

It is also, I think, to be preferred to the lime water, or the wood ashes and lime, which Mr. Forsyth recommends to be used for the removal of insects. It is preferable to the lime water and the lime, because lime loses its causticity, and with that its efficacy, by exposure to air, and must consequently be frequently applied; and to the dredging the leaves with the fine dust of wood ashes and lime, because the same effect is produced by the mixture without the same labour, and is obtained without expense.

Mr. Speechley, in his treatise on the Vine, published in 1796, has used this mixture with great success; but he has applied it awkwardly and wastefully. He directs it to be poured from a ladder out of "a watering pot over both trees and wall, beginning at the top of the wall, and bringing it on in courses from top to bottom:" page 161. Mr. Speechley is not the first person who has thought of this application of the mixture. It is a fact which has been long known and neglected.

A considerable extent of wall may be washed by means of a common garden pump in a short time; and this operation should be repeated as often as a supply of the mixture can be procured; or if the water of a washing cannot be had, a quantity of potash of commerce dissolved in water may be substituted.* The washing of the trees and wall twice a week for three or four weeks in the spring will be sufficient to secure them from the injuries of these insects.

On the whole, then, this must be considered as a valuable manure, as it can be obtained easily, at small expense, and in large quantities; and, when its nature is well understood, will probably be no less esteemed by the farmer than horse dung. To the gardener, as well as to the farmer, it is useful, mixed with mould, as a fertilizing compost; or, when fluid may be applied to his fruit-walls, as a wash fatal to the noxious brood of predatory insects.

THOMAS FALCONER.

NO. 59.

On the Revival of an Obsolete Mode of managing Strawberries. By the Right Honourable Sir JOSEPH BANKS, *Bart. K. B. P. R. S. &c.*†

THE custom of laying straw under strawberry plants, when their fruit begins to smell, is probably very old in this country: the name of the fruit bears testimony in favour of this conjecture; for the plant has no relation to straw in any other way, and no other European language applies the idea of straw in any shape to the name of the berry, or to the plant that bears it.

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* Mr. Speechley uses his mixture warm, to soak the shreds, and wash the wall, more effectually.

† Nicholson, vol. 19, p. 95. From the *Transactions of the Horticultural Society*, vol. 1, part i, p. 54.

When sir Joseph Banks came to Spring Grove, in 1779, he found this practice in the garden: John Smith, the gardener, well known among his brethern as a man of more than ordinary abilities in the profession, had used it there many years; he learned it soon after he came to London from Scotland; probably at the Neat Houses, where he first worked among the market gardeners, it is therefore clearly an old practice, though now almost obsolete.

Its use in preserving a crop is very extensive: it shades the roots from the sun; prevents the waste of moisture by evaporation, and, consequently, in dry times, when watering is necessary, makes a less quantity of water suffice than would be used if the sun could act immediately on the surface of the mould; besides, it keeps the leaning fruit from resting on the earth, and gives the whole an air of neatness as well as an effect of real cleanliness, which should never be wanting in a gentleman's garden.

The strawberry beds in that garden at Spring Grove, which has been measured for the purpose of ascertaining the expense incurred by this method of management, are about seventy-five feet long, and five feet wide, each containing three rows of plants, and of course requiring four rows of straw to be laid under them. The whole consists of six hundred feet of beds, or eighteen hundred feet of strawberry plants, of different sorts, in rows. The strawing of these beds consumed this year, 1806, the long straw of twenty-six trusses, for the short straw being as good for litter as the long straw, but less applicable to this use, is taken out; if we allow then, on the original twenty-six trusses, six for the short straw taken out and applied to other uses, twenty trusses will remain, which cost this year ten pence a truss, or sixteen shillings and eight pence, being one penny for every nine feet of strawberries in rows.

From this original expenditure the value of the manure made by the straw when taken from the beds must be deducted, as the whole of it goes undiminished to the dunghill as soon as the crop is over. The cost of this practice, therefore, cannot be considered as heavy; in the present year not a single shower fell at Spring Grove, from the time the straw was laid down till the crop of scarlets was nearly finished at the end of June. The expense of strawing was therefore many times repaid by the saving made in the labour of watering, and the profit of this saving was immediately brought to account in increase of other crops, by the use of water spared from the strawberries; and besides, the berries themselves were, under this management, as fair and nearly as large as in ordinary years, but the general complaint of the gardeners this year was, that the scarlets did not reach half their natural size, and of course required twice as many to fill a pottle as would do it in a good year.

In wet years the straw is of less importance in this point of view, but in years moderately wet, the use of strawing sometimes makes watering wholly unnecessary, when gardeners who do not straw are under the necessity of resorting to it; and we all know if watering is once begun, it cannot be left off till rain enough has fallen to give the ground a thorough soaking.

Even in wet years the straw does considerable service, heavy rains never fail to dash up abundance of mould, and fix it upon the berries, this is entirely prevented, as well as the dirtiness of those berries that lean down upon the earth, so that the whole crop is kept pure and clean: no earthy taste will be observed in eating the fruit that has been strawed, and the cream which is sometimes soiled when mixed with strawberries, by the dirt that adheres to them, especially in the early part of the season, will retain to the last drop that unsullied red and white, which give almost as much satisfaction to the eye while we are eating it, as the taste of that most excellent mixture does to the palate.

No. 60.

On the Advantages of Grafting Walnut, Mulberry, and Chesnut Trees. By THOMAS ANDREW KNIGHT, *Esquire, F. R. S. &c.*[*]

IN the course of very extensive experience in the propagation of apple and pear trees, I found that the detached parts of the bearing branches of old trees of those species, when employed as grafts, never formed what could with propriety be called young trees: the stocks appeared to afford nutriment only; and the new plants retained, in all instances, the character and habits of the bearing branches of which they once formed parts; and generally produced fruit the second or third year after the grafts had been inserted.[†]

I was therefore induced to hope, that the effects of time might be anticipated in the culture of several fruits, the trees of which remain unproductive during many years after they are planted: and that parts of the bearing branches of those, detached from the old trees, and employed as grafts, would still retain the character and habits of bearing branches.

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[*] Nicholson, vol. 19, p. 175. From the *Transactions of the Horticultural Society*, vol. 1, p. 60.

[†] Columella appears to have known, that a cutting of a bearing branch did not form a young tree; for speaking of cuttings of the vine (semina) he says, "optima habentur a lumbis; secunda ab humeris; tertia summa in vite lecta, quæ celerrime comprehendunt, et sunt feraciora, sed et quam celerrime senescunt." *De Arboribus*, chap. 3.

Having therefore planted in the spring of 1799 some walnut trees, of two years old, in garden pots, I raised them up to the bearing branches of an old walnut tree, by placing them on the top of poles placed in the earth; and I grafted them, by approach, with parts of the bearing branches of the old tree. A union took place during the summer, and in the autumn the grafts were detached from the parent stock. The plants thus obtained were planted in a nursery, and without any peculiar care or management, produced both male and female blossoms in the third succeeding spring, and have since afforded blossoms every season. The frost has, however, rendered their blossoms, as well as those of other trees in their vicinity, wholly unproductive during the last three years, and in the spring of 1805, almost wholly destroyed the wood of the preceding year. A similar experiment was made in the same year, but under many disadvantages, on the mulberry tree. I had not any young plants of this tree, and therefore could only make the experiment with scions of one year old; and of these I had only two, which had sprung from the roots of a young tree, in the preceding year. These were planted in pots, and raised to the bearing branches of an old tree, in the manner I have already described in speaking of the walnut tree. One of these scions died; the other, which had but very few roots, succeeded; and the young grafted tree bore fruit the third year, and has continued annually productive. In the last spring I introduced it into my vinery, where its fruit ripened in the greatest state of perfection, in the beginning of the present month, [January, 1807].

Both the walnut and mulberry tree succeed so ill when grafted, unless by approach, that I can scarcely recommend attempts to propagate them in any other way: but when they succeed by other modes of grafting, nearly the same advantages will probably be obtained: the habit of the bearing branch is, however, least disturbed by grafting by approach.

The Spanish chesnut succeeds readily when grafted in almost any of the usual ways, and when the grafts are taken from bearing branches, the young trees afford blossoms in the succeeding year: and I am much inclined to think, from experiments I have made on this tree, that by selecting those varieties which ripen their fruit early in the autumn, and by propagating with grafts or buds from young and vigorous trees of that kind, which have just attained the age necessary to enable them to bear fruit, it might be cultivated with much advantage in this country, both for its fruit and timber.

I have tried similar experiments on many other species of trees, and always with the same result; and I entertain no doubt, that the effects of time might be thus anticipated in the culture of any fruit, which is not produced till the seedling trees acquire a considerable age. For I am thoroughly confident, from very extensive and long experience, that the graft derives nutriment only, and not growth, from the young stock in which it is inserted; and that with the life of the parent stock the graft retains its habits and its constitution.

No. 61.

An Inquiry into the Causes of the Decay of Wood, and the Means of preventing it. By CHARLES H. PARRY, *M. D.**

THE power of wood in different forms to supply luxury, to promote science, and to guard and prolong human life, has made the means of preserving it from decay highly interesting to mankind. With this view various premiums have been offered by this and other economical societies. The object of the following discussion is to suggest the best means of prevention, chiefly by inquiring into the nature and sources of the evil against which it is intended to guard.

Wood, when killed by being separated from its root, is subject to gradual destruction from two causes,—rotting, and the depredations of insects.

Of the rot there are two supposed kinds, as they affect wood, first, in the open air, or secondly, under cover.

The first is that which, in the terms of our premium, Class 7, No. 3, is said to occur to "barn and other outside doors, weather-boarding, gates, stiles, and implements of husbandry:" To which, if there were any need of this minute specification, might have been added posts, rails, paling, water-shoots, and various other objects.

The second is well known under the name of the dry-rot, the cause and prevention of which are the subjects of a premium by the Society of Arts in London.

Animal and vegetable substances possess certain common properties and movements, which constitute what is called life. When that state ceases, and these properties and motions no longer exist, the bodies become subject to the chemical and mechanical laws of all other matter.

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* Nicholson, vol. 19, p. 328. From *Papers of the Bath and West of England Society*, vol. 11, p. 226.

When perfectly dry, and in certain degrees of temperature, both seem to be scarcely capable of spontaneous decay. On this principle vast quantities of salmon are annually conveyed in a frozen state to London from the north of England and Scotland; and the inhabitants of the still more northern regions constantly preserve their food, by freezing, unchanged through the longest winters. The gelatinous and other soluble parts of animal substances, when extracted by boiling, and kept in a soft moist state, very readily putrify. But if the same matter be dried by a gentle heat, and secluded from moisture and air by being kept in bottles or metallic cases, it will remain very long without decay. This is the theory of that well-known and useful substance, portable soup. In the burning climate of Africa, when it is intended to preserve a dead animal for food, all that is necessary is to cut the muscular parts into thin strips, from which, in a few hours, the heat of the sun exhales all moisture, reducing them to a substance like leather or horn, which proves to be unsusceptible of future decay from putrefaction. So also entire human bodies, buried in the arid sands of those countries, have often been found converted by exhalation and absorption of their natural moisture into a dry hard sort of mummy, incapable of any farther change from the agency of those causes, to which, in such situations, they are exposed.

Similar causes produce the same effects on wood. Even under less rigid circumstances of this kind, as in the roofs and other timber of large buildings, it continues for an astonishing length of time unchanged; witness the timber of that noble edifice, Westminster Hall, built by Richard II, in 1397; and the more extraordinary instance quoted by Dr. Darwin, in his ingenious work, the Phytologia, of the gates of the old Saint Peter's church, in Rome, which were said to have continued without rotting, from the time of the emperor Constantine to that of pope Eugene IV, a period of eleven hundred years. On the other hand, wood will remain for ages with little change, when continually immersed in water, or even when deeply buried in the earth; as in the piles and buttresses of bridges, and in various morasses. These latter facts seem to show, that, if the access of atmospherical air is not necessary to the decay of wood, it is, at least, highly conducive to it.

In posts fixed in the ground and exposed to the weather, we constantly find that part soonest decay, which is just above or within the ground. So also where there is an accidental hole in an exposed surface, or any artificial cavity, as in a mortice and tenon, or the part where pales nearly touch the rails on which they are nailed, there the wood universally begins first to moulder away. The same thing happens with regard to horizontal rails themselves, which, when made of the same materials, rot much sooner than the pales which they support. These facts are very easily explained. They clearly show, that the great cause of decay is the constant action of water aided by air, which most affects those points, where it is most retained, but has less operation, where, as in the perpendicular pales, it chiefly runs off by its own gravity, so that the little which remains is easily and quickly abstracted by the co-operating power of the sun and wind.

The change which I am describing is the consequence of putrefactive fermentation; a chemical operation, in which the component parts of the wood form new combinations among themselves, and with the water which is essential to the process. The precise nature of these new compounds has not been ascertained; but, so far as they are known, they consist of certain gases, or species of air, which fly off, and leave behind a powder, consisting chiefly of carbon or charcoal, and the earth which entered into the original composition of the wood.

Beside this chemical change depending on water, that substance tends to destroy wood exposed to the open air by a mechanical operation. Every farmer is acquainted with the power of winter in mouldering down the earth of his fallows. It is equally well known, that porous freestone splits and shivers during severe winters. These effects are produced by frost, which, acting on the water in the pores or interstices of these substances, expands it by conversion into ice, and thus bursts the minute cells in which it was contained. There can be no doubt, that a similar operation takes place to a certain extent in exposed wood, and thus in some degree promotes its destruction.

It appears, then, that the contact of water and air are the chief causes of the decay of wood. If, therefore, any means can be devised, by which the access of moisture and air can be prevented, the wood is so far secure against decay. This principle may be illustrated by supposing a cylinder of dry wood to be placed in a glass tube or case, which it exactly fills, and the two ends of which are, as it is called, hermetically sealed, that is, entirely closed by uniting the melted sides of each end of the tube. Who will doubt that such a piece of wood might remain in the open air a thousand years unchanged? Or let us take a still more apposite illustration of this fact; that of amber, a native bitumen, or resin, in which a variety of small flies, filaments of vegetables, and others of the most fragile substances are seen imbedded, having been preserved from decay much longer probably than a thousand years, and with no apparent tendency to change for ten times that period. Let us see then if we cannot, by the exclusion of moisture and air, find means of virtually placing our timber in a case of glass or amber.

With this view, various expedients have been employed, of which the most common is covering the surface with paint; which is oil mixed with some substance capable of giving it the colour which we desire. It is well known, that several of the oils, as those of linseed, hempseed, &c. become dry when thinly spread on any hard substance. The drying quality is much assisted by their being previously boiled with certain metallic oxides, more especially that of lead, litharge. The crust so formed is with difficulty penetrated by moisture or air. For this purpose drying oil is spread on silk or linen, in the manufacture of umbrellas; and will tolerably well succeed in confining hydrogen gas, or inflammable air, in the construction of air-balloons. Hence we see the mode in which the application of paint on wood serves to defend it against the causes of destruction.

When paint is employed within doors, it is customary to add to the oil, beside the colouring matter, some essential oil of turpentine, which not only makes it dry more readily, but, by giving it greater tenuity, causes it to flow more freely from the brush, and therefore to go farther in the work. For the same purposes I observe it forms a part of the paint used on wood and iron work in the open air; but, as it appears to me, most improperly: For I have remarked that on rubbing wood painted white, and long exposed to the weather, the white lead has come off in a dry powder like whiting; as if the vehicle which glued it to the wood had been decomposed and lost, leaving only the pigment behind: And I have been much inclined to suspect, that this has arisen from the oil having been too much *opened,* as the workmen call it, or having its thickness and tenacity too much diminished by a superabundance of the oil of turpentine. In this state it may, in various ways, be more readily acted on by water and air. We know, that the properties of what are called unctuous or fat oils are much changed by the admixture of the volatile or essential oils. On this principle we succeed in getting grease out of woollen cloths by oil of turpentine; but whether the same change is produced on the drying oils, I have not learned.

It appears, then, that these drying oils either by themselves, or boiled with metallic oxides, will form a varnish on wood; but it may be questioned how far the colouring matters, with which they are usually mixed, contribute to increase their preservative power. I do not, however, deny, that they may be serviceable in this and other views. They might be supposed to enable the oil to lay firmer hold, as it were, on the wood; and they may serve to increase the thickness of the defensive covering. The first of these points is of some importance; for we observe that the paint on street doors, which is become thick by frequent incrustation, is apt, from the strong influence of the summer's sun, to separate from the polished wood beneath, and rise in large blisters; probably in consequence of a greater expansion in the crust itself than in the subjacent wood. Here, therefore, the colouring matter of the paint fails to produce the desired effect; and as to the second end, or that of increasing the thickness of the covering, that may, probably, be much more effectually accomplished than by the mere addition of pigments, some of which are capable of chemical decomposition, and all are costly. This purpose an ingenious artist has of late attempted to answer, by recommending an admixture of road-dust; and for that and other means of reducing the price of paints, has obtained a premium from the London Society of Arts. However just the general principle in this case may be, the application is somewhat unphilosophical; unless it shall be found, which will scarcely be admitted, that dust of every chemical and mechanical quality will equally or sufficiently answer the intended purpose.

Some material of this kind, selected with greater precision, may however undoubtedly be useful; and none I think promises more fairly than siliceous or flinty sand, which, so far as we know, is absolutely indestructible, and which may be easily procured from the sea-shore, and from the currents of the clear rivers and roads in Berkshire and other counties abounding with siliceous stones. Sand from the sea must first be cleared from all saline impregnations by washing in several waters; and any sand may be obtained of the fineness desired, by mixing it with water in a tub, and after having stirred the whole well together, pouring out, in a longer or shorter time, the muddy water, from which the sand will settle by its own gravity, in a state fit for use when dried.

More than thirty years ago this subject presented itself to my mind, on seeing some water-shoots, which had been pitched and painted in the common way, taken down in a state of complete rottenness. I had read that charcoal, buried in the moist earth, had come down to us perfectly sound from the times of the Romans; and that posts long withstood the same moisture, if the part intended to be put into the ground was charred all round to a certain depth. Impressed with these facts, I determined to try an artificial coat of charcoal; and when new water-shoots were constructed, I strongly and carefully rubbed them with a coat of drying oil, which I immediately dredged all over with a thick layer of charcoal finely powdered, and contained in a muslin bag. After two or three days, when the oil was thoroughly dried, and firmly retained the greatest part of the charcoal, I brushed off what was loose, and over that which adhered I applied a coat of common lead-coloured paint, and a few days after, a second. The whole became a firm and solid crust; after which the shoots were put into their places, and being examined many years afterward, appeared perfectly sound. Any other colour would probably have succeeded equally well with that which I employed. I do not think that lamp black, which is a pure species of charcoal, would have answered the purpose of forming a thick defensive covering so well as the grosser charcoal which I used. But whatever sort of charcoal is employed, it ought either to be fresh made, or heated again in close vessels, so as to expel the water which it greedily attracts from the air.

To all compositions formed from drying vegetable oils there is this objection; that however well they may answer the end proposed, they are too dear for that great consumption, which is usually required for outside work. For this and other reasons, various other substances have been employed for the same purpose.

Of these the most common is pitch, which is well known to be the resinous matter melted by heat out of the pine tribe of trees in form of tar, and afterwards hardened by evaporation. It is applied hot, and when cold, makes a moderately hard varnish. It does not however appear, in fact, to answer the purpose so well as might have been expected. The sun at first melts it, so that it runs off in drops, or adheres to every thing which touches it; and the united influence of air and water seems to make it brittle and powdery like resin. Experience, therefore, shows it to be of little value. Neither is it probable that its powers would be much improved by admixture with charcoal, sand, or other similar substances. Many members of this Society may recollect its application twenty years ago on the red-deal shingled roofs of part of our market. In this case it was used hot, mixed with Spanish brown, and hardened by sand sifted over it with a sieve; notwithstanding which it seems to have left the wood like the unmixed pitch, and, though frequently renewed, has not prevented the necessity of various repairs within these last five years. The original boards are now every where more or less in a state of decay.

The bituminous substance melted by heat out of coal, and commonly called coal tar, has been strongly recommended for this purpose by that ingenious philosopher Lord Dundonald. I have tried it largely and unsuccessfully, though perhaps not fairly; for the workmen whom I employed, in order to make it work more easily, added to it oil of turpentine, which certainly diminished its durability by rendering it more miscible with water. I am however inclined to believe, that no substance of this kind, used by itself, will become sufficiently dry and hard to resist the influence of the weather.

As animal oils are considerably cheaper than those expressed from vegetables, attempts have been made to communicate to them a drying quality. This has been effected by dissolving in them while hot various substances capable of being melted, in such a portion that the whole mass would become dry and hard when cold. Bees' wax, resin, and brimstone are found to have this property. Some of them, when united with drying oil, have long been employed for making boots and shoes water-proof, or impervious to moisture.* But they will also succeed when mixed with train oil, which is obtained from the blubber of the whale. In the second volume of the Memoirs of this Society, printed in the year 1783, there is the following receipt. "Melt twelve ounces of resin in an iron pot or kettle; add three gallons of train oil and three or four rolls of brimstone; and when the resin and brimstone are melted and become thin, add as much Spanish brown, or red or yellow ochre, or any colour you want, first ground fine with some of the oil, as will give the whole as deep a shade as you like. Then lay it on with a brush as hot and thin as you can. Some days after the first coat is dried, give it a second. It will preserve plank for ages, and keep the weather from driving through brick-work." Page 114.

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* For this purpose there is the following receipt by Mr. Barker, in sir John Hawkins's edition of that entertaining work, Isaac Walton's Complete Angler: fourth edition, page 223. "Take a pint of linseed oil, with half a pound of mutton suet, six or eight ounces of bees' wax, and half a pennyworth of resin. Boil all this in a pipkin together; so let it cool till it be milk-warm. Then take a little hair-brush, and lay it on your new boots; but it is best that this stuff be laid on before the boot-maker makes the boots; then brush them once over with it after they come from him. As for old boots, you must lay it on when your boots be dry."

This composition I tried about eighteen years ago on some elm paling, substituting for the colouring matter one or two coats of common white paint for the sake of the appearance. This paling appears to me to be in every part of it, which was covered, as sound as when it was first put up.

As compositions of the resinous kind are apt to crack and become powdery, like the varnish of carriages, by exposure to weather, it is not improbable, that this effect may be in some measure counteracted by the mixture of a small proportion of bees' wax. Such a compound I have used, but in the quantity of eight ounces to the gallon found it too slow in drying, and capable of being easily scraped off with the nail. Wax is also at this time very scarce and dear.

All the substances contained in these mixtures are capable of perfect incorporation with each other by heat, and when separately exposed, are with great difficulty acted on by water or air in any heat which occurs in our climate. They should be applied hot with a common painter's brush on the wood which is previously very dry, so as to sink deeply into its pores; and though at first they are apparently somewhat greasy when cold, yet after some days they make a firm varnish, which does not come off on rubbing. When it is required to give beauty to the work, colouring matters may either be added to the mixture, or afterward applied over it in form of common paint. Two coats of the composition should always be given; and in all compound machinery, the separate parts should be so varnished before they are put together; after which it will be prudent to give a third coating to the joints, or to any other part which is peculiarly exposed to the action of moisture, such as water-shoots, flood gates, the beds of carts, the tops of posts and rails, and all timber which is near or within the ground. Each coat should be dry before the parts are joined, or the last coat applied.

These compositions are equally efficacious in keeping iron from decay by rusting. They might also be very advantageously employed in rendering water-tight the plaister which is used to case the outside of the arches of vaults unsheltered by roofs, provided the mortar were made perfectly dry, and the covering of the arch brought up to an angle, instead of making it follow the form of the arch in an elipse or the segment of a circle.

It is necessary to mention, that compositions made of hot oil should for the sake of security be heated in metallic or glazed earthen vessels in the open air. For whenever oil is brought to the boiling point, or 600° of Fahrenheit's thermometer, the vapour immediately catches fire, although not in contact with any flame; and though a lower degree of temperature than that of boiling should be used in this process, it is not always practicable either exactly to regulate the heat, or to prevent the overflowing of the materials, in either of which cases, were the melting performed in a house, the most fatal accidents might follow.

The following is the proportion of the above ingredients, and the mode of mixing them, which I should recommend.

Take twelve ounces of resin, and eight ounces of roll brimstone, each coarsely powdered, and three gallons of train-oil. Heat them slowly, gradually adding four ounces of bees'-wax, cut into small bits. Frequently stir the liquor, which, as soon as the solid ingredients are dissolved, will be fit for use. What remains unused will become solid on cooling, and may be re-melted on subsequent occasions.

If the addition of charcoal powder or siliceous sand contributes to the durability of drying oil, it may probably have a similar effect on this composition; but whether it may be best to mix them with the ingredients, or apply them afterward, I cannot from experience tell. In the latter case, the powder should be sifted on, while the first coat of the composition is still hot; and, after some days, when that is dry, should have a brush gently passed over it, in order to remove all the particles which do not adhere; after which other coats of the composition may be applied, as before directed.

This is all which occurs to me as to the mode of preserving wood when exposed to the weather.

(*To be concluded in our next number.*)

NO. 62.

Description of the Method employed at Astracan for making grained Parchment or Shagreen. By Professor PALLAS.*

THE process for preparing shagreen is a very old oriental invention, not practised in Europe, and which, as far as I know, has never yet been described; though Basil Valentin* is pretty right in what he says of it in general. It is one of those arts of the East, which, like that of the Turkey dye for cotton, the preparation of Russia leather, isinglass, &c. have remained unknown and unemployed, not because they are kept secrets, but because none of the European travellers ever took the trouble to learn them, and because the materials used are not so common and so cheap in Europe. It may be of some utility, therefore, if I here give a circumstantial description of this art as it is practised at Astracan by the Tartars and Armenians, especially as the method of these people is perfectly similar to that used in Turkey, Persia, and various parts of Bucharia, and as the shagreen-makers of Astracan acknowledge that they obtained the process originally from Persia.

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* Tilloch, vol. 6, p. 217.

All kinds of horses' or asses' skin, which have been dressed in such a manner as to appear grained, are by the Tartars called *sauwer*, by the Persians *sogre*, and by the Turks *sagri*, from which the Europeans have made *shagreen* or *chagrin*. The Tartars who reside at Astracan, with a few of the Armenians of that city, are the only people in the Russian empire acquainted with the art of making shagreen. Those who follow this occupation not only gain considerable profit by the sale of their production to the Tartars of Cuban, Astracan, and Casan, who ornament with it their Turkey leather boots, slippers, and other articles made of leather; but they derive considerable advantage from the great sale of horses' hides, which have undergone no other process than that of being scraped clean, and of which several thousands are annually exported, at the rate of from seventy-five to eighty-five roubles per hundred, to Persia, where there is a scarcity of such hides, and from which the greater part of the shagreen manufactured in that country is prepared. The hind part only of the hide, however, which is cut out in the form of a crescent about a Russian ell and a half in length across the loins, and a short ell in breadth along the back, can properly be employed for shagreen. The remaining part, as is proved by experience, is improper for that purpose, and is therefore rejected.

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* See *M. B. Valentini Museum Museorum oder Vollſtändige Schaubühne aller materiallien und specereyen*, p. 439.

The preparation of the skins, after being cut into the above form, is as follows:—They are deposited in a tub filled with pure water, and suffered to remain there for several days, till they are thoroughly soaked, and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction against a wall, the corners of them, which reach beyond the edges of the board, being made fast, and the hair with the epidermis is then scraped off with a blunt iron scraper called *urak*. The skins thus cleaned are again put in pure water to soak. When all the skins have undergone this part of the process, they are taken from the water a second time, spread out one after the other as before, and the flesh side is scraped with the same kind of instrument. They are carefully cleaned also on the hair side, so that nothing remains but the pure fibrous tissue, which serves for making parchment, consisting of coats of white medullary fibres, and which has a resemblance to a swine's bladder softened in water.

After this preparation, the workmen take a certain kind of frames called *pälzi*, made of a straight and a semi-circular piece of wood, having nearly the same form as the skins. On these the skins are extended in as smooth and even a manner as possible by means of cords; and during the operation of extending them they are several times besprinkled with water, that no part of them may be dry, and occasion an unequal tension. After they have been all extended on the frames, they are again moistened, and carried into the house, where the frames are deposited close to each other on the floor with the flesh side of the skin next the ground. The upper side is then thickly bestrewed with the black exceedingly smooth and hard seeds of a kind of goose-foot, (*chenopodium album*,)* which the Tartars call *alabuta*, and which grows in abundance, to about the height of a man, near the gardens and farms on the south side of the Volga; and that they may make a strong impression on the skins, a piece of felt is spread over them, and the seeds are trod down with the feet, by which means they are deeply imprinted into the soft skins. The frames, without shaking the seeds, are then carried out into the open air, and placed in a reclining position against a wall to dry, the side covered with the seeds being next the wall, in order that it may be sheltered from the sun. In this state the skins must be left several days to dry in the sun, until no appearance of moisture is observed in them; when they are fit to be taken from the frames. When the impressed seeds are beat off from the hair side, it appears full of indentations or inequalities, and has acquired that impression which is to produce the grain of the shagreen, after the skins have been subjected to the last smoothing or scraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

The operation of smoothing is performed on an inclined bench or board, which is furnished with an iron hook, and is covered with thick felt or sheep's wool on which the dry skin may gently rest. The skin is suspended in the middle of the bench or board to its iron hook, by means of one of the holes made in the edge of the skin for extending it in its frame as before mentioned; and a cord, having at its extremity a stone or a weight, is attached to each end of the skin, to keep it in its position while under the hands of the workman. It is then subjected to the operation of smoothing and scraping by means of two different instruments. The first used for this purpose, called by the Tartars *tokar*, is a piece of sharp iron bent like a hook, with which the surface of the shagreen is pretty closely scraped to remove all the projecting inequalities. This operation, on account of the corneous hardness of the dry skin, is attended with some difficulty; and great caution is at the same time required that too much of the impression of the *alabuta* seed be not destroyed, which might be the case if the iron were kept too sharp. As the iron, however, is pretty blunt, which occasions inequalities on the shagreen, this inconvenience must afterwards be remedied by means of a sharp scraping-iron or *urak*, by which the surface acquires a perfect uniformity, and only faint impressions of the *alabuta* seed then remain, and such as the workman wishes. After all these operations, the shagreen is again put into water, partly to make it pliable, and partly to raise the grain. As the seeds occasion indentations in the surface of the skin, the intermediate spaces, by the operations of smoothing and scraping, lose some part of their projecting substance; but the points which have been depressed, and which have lost none of their substance, now swell up above the scraped parts, and thus form the grain of the shagreen. To produce this effect, the skins are left to soak in water for twenty-four hours;

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* This chenopodium is often used as food by the German colonists on the Volga, on account of the frequent failure of their crops. They employ it either as a substitute for greens, or pound the seeds, and, with the addition of a little meal, form them into bread.

after which they are immersed several times in a strong warm ley, obtained, by boiling, from a strong alkaline earth named *schora*, which is found in great abundance in the neighbourhood of Astracan. When the skins have been taken from this ley, they are piled up, while warm, on each other, and suffered to remain in that state several hours; by which means they swell, and become soft. They are then left twenty-four hours in a moderately strong pickle of common salt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour most usual for these skins is a sea-green; but old experienced workmen can dye them blue, red, or black, and even make white shagreen.

For the green colour nothing is necessary but filings of copper and sal-ammoniac. Sal-ammoniac is dissolved in water till the water is completely saturated; and the shagreen skins, still moist, after being taken from the pickle, are washed over with the solution on the ungrained flesh side, and when well moistened a thick layer of copper filings is strewed over them: the skins are then folded double, so that the side covered with the filings is innermost. Each skin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are pressed down in an uniform manner by some heavy bodies placed over them, under which they remain twenty-four hours. During that period the solution of sal-ammoniac dissolves a quantity of the cupreous particles sufficient to penetrate the skin and to give it a sea-green colour. If the first application be not sufficient, the process is repeated in the same manner; after which the skins are spread out and dried.

For the blue dye, indigo is used. About two pounds of it, reduced to a fine powder, are put into a kettle; cold water is poured over it, and the mixture is stirred round till the colour begins to be dissolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude soda, prepared by the Armenians and Calmucs, is then dissolved in it, with two pounds of lime* and a pound of pure honey, and the whole is kept several days in the sun, and during that time frequently stirred round. The skins intended to be dyed blue must be moistened only in the natrous ley *schora*, but not in the salt brine. When still moist, they are folded up and sewed together at the edge, the flesh side being innermost, and the shagreened hair side outwards; after which they are dipped three times in the remains of an exhausted kettle of the same die, the superfluous dye being each time expressed; and after this process they are dipped in the fresh dye prepared as above, which must not be expressed. The skins are then hung up in the shade to dry; after which they are cleaned and paired at the edges.

For black shagreen, gall-nuts and vitriol are employed in the following manner:—The skins, moist from the pickle, are thickly bestrewed with finely pulverised gall-nuts. They are then folded together, and laid over each other for twenty-four hours. A new ley, of bitter saline earth or *schora*, is in the mean time prepared, and poured hot into small troughs. In this ley each skin is several times dipped; after which they are again bestrewed with pounded gall-nuts, and placed in heaps for a certain period, that the galls may thoroughly penetrate them, and they are dried and beat, to free them from the dust of the galls. When this is done, they are rubbed over, on the shagreen side, with melted sheep's tallow, and exposed a little in the sun, that they may imbibe the grease. The shagreen-makers are accustomed also to roll up each skin separately, and to press or squeeze it with their hands against some hard substance, in order to promote the absorption of the tallow. The superfluous particles are removed by means of a blunt wooden scraper (*urak*); and when this process is finished, and the skins have lain some time, a sufficient quantity of vitriol of iron is dissolved in water, with which the shagreen is moistened on both sides, and by this operation it acquires a beautiful black dye. It is then dressed at the edges, and in other places where there are any blemishes.

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* Quick-lime is probably meant here, which, by taking up the carbonic acid of the alkali, and thereby rendering it caustic, will enable it to effect a mechanical solution, or rather an impalpable comminution, of the indigo.—TILLOCH.

To obtain white shagreen, the skins must first be moistened, on the shagreen side, with a strong solution of alum. When the skin has imbibed this liquor, it is daubed over on both sides with a paste made of flour, which is suffered to dry. The paste is then washed off with alum water, and the skin is placed in the sun till it is completely dry. As soon as it is dry, it is gently besmeared with pure melted sheep's tallow, which it is suffered to imbibe in the sun; and, to promote the effect, it is pressed and worked with the hands. The skins are then fastened in succession to the before-mentioned bench, where warm water is poured over them, and the superfluous fat is scraped off with a blunt wooden instrument. In the last operation the warm water is of great service. In this manner shagreen perfectly white is obtained, and nothing remains but to pair the edges and dress it.

But this white shagreen is not intended so much for remaining in that state as for receiving a dark red dye, because, by the above previous process, the colour becomes much more perfect. The skins destined for a red colour must not be immersed first in ley of bitter salt earth, (*schora*,) and then in pickle, but, after they have been whitened, must be left to soak in the pickle for twenty-four hours. The dye is prepared from cochineal, which the Tartars call *kirmitz*. About a pound of the dried herb *tschagann*, which grows in great abundance in the neighbourhood of Astracan, and is a kind of soda-plant or kali, (*salsola ericoides*,)* is boiled a full hour in a kettle containing about four common pailfulls of water; by which means the water acquires a greenish colour. The herb is then taken out, and about half a pound of pounded cochineal is put into the kettle, and the liquor is left to boil a full hour, care being taken to stir it that it may not run over. About fifteen or twenty drams of a substance which the dyers call *lüter* (orchilla) is added, and when the liquor has been boiled for some time longer the kettle is removed from the fire. The skins taken from the pickle are then placed over each other in troughs, and the dye-liquor is poured over them four different times, and rubbed into them with the hands, that the colour may be equally imbibed and diffused. The liquor each time is expressed; after which they are fit for being dried. Skins prepared in this manner are sold at a much dearer rate than any of the other kinds.

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* The beautiful red Turkey leather is dyed with cochineal prepared in the same manner. Professor Gmelin, junior, in the second part of his Travels through Russia, explains the herb *tschagann* by *artemisia annua*, having doubtless been deceived by the appearance the plant acquires after it has been dried. Besides, this *artemisia* is found only in the middle of Siberia, and never on the west side of the Irtisch.

No. 53.

List of American Patents.

(Continued from page 240.)

1808.

Asahel E. Paine, July 1, a washing machine.

Dyer Cleveland, July 7, improvement in the churn.

Robert Ramsey, July 9, a pressing and boring machine.

Samuel Parker, July 9, improvement in tanning.

Samuel Parker, July 9, improvement in currying and finishing leather.

Abel Brewster, July 11, the universal vitriolic test, for making all kind of bank or other bills.

Enos Trescott, July 11, a washing machine.

Theron Henry, July 11, a washing machine.

Thomas Osgood, July 11, a washing machine.

Ebenezer Lister, July 11, a washing machine.

Dudley Loomis and Ira Millington, July 11, a washing machine.

Dyer Cleveland, July 11, improvement in the churn.

Erastus Townsend, July 12, improvement in churns.

Isaac Cobb, July 12, machine for splitting skins.

Jonathan Lucas, junior, July 12, machine for cleaning rice.

Eli Barnum and Benjamin Brooks, July 13, improvement in distilling.

Philip Apple, July 13, improvement in funnels for filling vessels with fluids.

Uzziel Geer, July 18, improvement in the wind mill.

Samuel Bartlett, July 19, improvement in rolling tub mills.

Martin Tullar, July 29, machine for shaving and splitting leather.

John Bolton, Aug. 2, improvement in churns.

Elihu Hotchkiss, Aug. 2, machine for cntting straw.

Obadiah Seeley, Aug. 6, improvement in the spinning wheel.

Jacob Coon, Aug. 6, machine for making wheels of all sorts.

John Thomas Ricketts, Aug. 8, machine for hulling and cleaning rice, and for many other purposes.

William Smith, Aug. 12, machine for elevating water at mills, &c.

James Finley and John Templemm, Aug. 16, improvement in chain bridges.

Joshua Cone, Aug. 26, improvement in carriage springs.

William Barker, Aug. 26, machine for raising water.

Stephen W. Dana, Aug. 30, a washing machine.

Stephen W. Dana, Aug. 30, improvement in wheel carriages.

Stephen Winchester, Aug. 31, a washing and churning machine.

Samuel Prince, Aug. 31, machine for pressing straw or chip hats, &c.

Samuel Gragg, Aug. 31, an elastic chair.

Gersham Cobb, Sept. 7, a geometrical interest table.

Garry Bishop, Sept. 7, a washing and churning machine.

Dan Parmele, Sept. 8, a rocking churn.

Asaph Chandler and Silas Shepard, Sept. 11, machine for heading nails.

Benjamin Atwell, Sept. 19, a fanning and winnowing mill.

Isaiah Jennings, Sept. 20, a pump bellows for furnaces and forges.

Marcus B. Parmelee, Sept, 21, a ratchet wheel.

Asa Frost, Sept. 21. improvement in making brick.

Paul Pilsbury, Sept. 22, machine for grinding bark, for tanning, &c.

William Burtis, Oct. 3, improvement in the taylor's bench.

Elisha Calendar, Oct. 3, improvement in lightning rods.

Thomas Bruff, Oct. 5, machine for making balls and shot by pressure.

John P. Lherbette, Oct. 7, improvement in military knapsacks.

Samuel Moon, junior, Oct. 24, improvement in churns.

John West, Oct. 27, improvement in ovens.

Jacob Cist, Oct. 28, a black pigment or mineral black for printing ink, or painting in oil or water.

Daniel Pettibone, Oct. 28, a rarefying air stove for warming rooms, &c.

Charles Cooper, Nov. 4, improvement in looms for weaving of every kind.

Randall Wallis, Nov. 9, machine for separating grain and seeds from straw, &c.

Simon B. Willard, Nov. 17, machine for scrubbing or scouring floors of houses, &c.

Eli Fourestier, Nov. 17, improvement in refining lamp oil.

Stedman Adams, Nov. 21, improvement in stills and rotary steam engines.

Samuel Chamberlain, Nov. 21, improvement in boots and shoes.

Joel Farnham, Nov. 23, improvement in Macomb's horizontal, re-acting water wheel.

Richard B. Chenoweth, Nov. 25, improvement in ploughs.

Stephen Mirick, Nov. 30, a rolling wheel on an inclined shaft.

John Devotie, Dec. 5, a churn and washing machine.

William Brown, Dec. 8, a mill for breaking plaister of paris, &c.

Rufus W. Adams, Dec. 8, improvement in grist mills.

Benjamin Giddins, Dec. 10, an elastic trace and brace, by connected springs.

Stephen Couch and Asa Towne, Dec. 10, machine for rolling and plating iron, and cutting nails.

Luther Jones, Dec. 10, improvement in the churn.

Isaac Bennitt, Dec. 12, improvement in still tubs.

Robert Nicholson and Thomas Nicholson, Dec. 13, machine for dressing shingles.

James P. Parke, Dec. 19, an alarm bell for fire engines.

Levi Martin, Dec. 19, improvement in the cheese press.

Anos Gunn, Dec. 19, a double boiler for distilling.

Willard Badger, Dec. 26, improvement in casting pipes or tubes.

Joseph Henderson, Dec. 26, mode of suspending or hanging pleasure carriages, &c.

Hezekiah Dickerman, Dec. 27, improvement in the cheese press.

John Dimond, Dec. 28, improvement in distillation.

Hazen Erwin, Dec. 28, a geer press for pressing cheese, &c.

George Rogers, Dec. 31, the vegetable pulmonic detergent.

THE

EMPORIUM

OF

ARTS AND SCIENCES.

Vol. 2.] March, 1813. [No. 11.

No. 64.

An Inquiry into the Causes of the Decay of Wood, and the Means of preventing it. *By* Charles H. Parry, *M. D.*

(Concluded from page 309.)

WHEN wood decays under cover, that condition is usually called the dry-rot. Let us examine the circumstances in which this change takes place.

It affects the interior doors, shelves, laths which subdivide the layers of wine, and all other wood work in certain cellars; beams and rafters which support the roofs of close passages; joists laying on or near the earth; the wainscoting of large rooms, little inhabited, in old and especially single houses; and wood in various other situations of a similar kind, which need not be particularized. In some of these cases, while one sample or portion of wood shall suffer the dry-rot, another specimen or portion shall remain unchanged. In other instances, wood of various kinds and qualities has been successively employed, and all has alike suffered. During the stages of change, a crop of mucor or mould, and very frequently of fungi, has sprung from the porous mass; and the decay is always attended with a wide-spreading exhalation, the odour of which cannot well be described, but which is sufficiently known.

What then are the causes of this destruction? Precisely the same as those which I have before described; though their action is differently modified, and less obvious to gross observation. The decay is produced by the putrefactive fermentation of the component parts of the wood, in connection with moisture, without which, as I have before stated, wood cannot putrefy.

Common air is not only capable of mixing with a considerable quantity of water in form of vapour, but during every state of our atmosphere is always much loaded with it. Water becomes vapour in consequence of being united with a certain proportion of that substance which is called heat. If a sufficiently cold substance comes into contact with vapour, the superabundant heat, which was necessary to its existence in that form, passes into that cold substance, and the vapour is then immediately condensed or changed into water. Thus if in the hottest day in summer, when the vapour in our breath is totally invisible, we breathe on a looking-glass or plate of polished metal, which is colder than our breath, the surface is immediately dimmed; and if we continue to breathe on it, small drops of liquid appear, which gradually become larger and larger, and many of them at length uniting, run down the surface in a stream. The same thing takes place on the outside of a glass of water drawn in summer from a deep well, and of a bottle brought up into a warm room out of a cool cellar; and on the inside of our windows in frosty weather. On the other hand, we could not dim with our breath a plate of metal or glass of one hundred degrees of heat, which is greater than that of our breath, and no mist is observable on the inside of our windows during the heat of a summer's day; nor is there any condensation of moisture on the outside of a glass of cold water fresh drawn from the well, or of a bottle out of a cellar, when either is brought into the open frosty air.

These circumstances will explain many appearances, by which, for want of due examination, we are often greatly puzzled. We are frequently mortified by seeing in our houses, especially in the country, the walls become stained, or the paper separated and hanging down, and often perishing; and as this usually happens on the side or corner which is most exposed to the weather, we conclude that the damp comes through the wall, and tax our faculties to the utmost, in order to prevent this penetration. The measures which we employ sometimes succeed. But it often happens, that casing, and plaistering, and painting the devoted angle fails; and then, as the last resource, we take off the paper and attach it to canvass at the distance of one or more inches from the wall, and thus, for the present at least, effect the desired purpose. Now in this case it is just as absurd to suppose, that the wet comes through the wall, as that it comes through the glass window in a frosty day, or the glass or bottle from the well or cellar. The fact is, that in an exposed house, and more especially on the most exposed corner of a room seldom warmed by fire, the inner surface of the wall, by the continuance of frost, is become of a very low temperature, like the air within the room itself. So long as this state of equal temperature between the wall and internal air continues, or if the wall is warmer than that air, it is obvious that the vapour which is mixed with the air cannot part with any heat to the wall, and therefore will not undergo condensation; just as no dampness appears on our windows during a hot day in summer. But if a thaw comes on, and the air becomes warmer than the wall, which, from its capacity of easily shifting place, it will readily do, then the vapour, which is mixed with it, parts with its superabundant heat to the colder wall, and appears on it in moisture or drops, or pours down it in streams; just as happens to the cold bottle brought into the warm dining-room.

This change is the greater, the more completely the materials of the wall fit it for carrying the heat out of the vapour, or, in philosophical language, the better hey conduct heat. Hence a wall painted in oil condenses vapour, or runs with water, sooner than one, which, being unpainted, is more porous; for which reason, in cities, we first perceive dampness and drops or streamlets of water on the oil-painted party walls which bound our staircases, and which are, therefore, absurdly said to sweat, though these walls have no communication with the outward air, and, from their varnished covering, cannot admit of the passage of moisture or perspiration through their pores.

In this case the remedy is obvious, and by its success shows the nature of the evil. Prevent your walls from ever becoming colder than the warmest external air of winter, and you will never have this appearance of damp on their inner surfaces.

This may be done, first, by constructing the walls of such a degree of thickness, or with such a disposition or quality of materials, that they shall not, in the usual way, be greatly cooled throughout their whole substance by any temperature of the outward air. With this view, I think that in all single hours, which are not warmed by neighbouring fires, and more especially in situations exposed to high winds, and therefore to great evaporation from the external surface, and consequent abstraction of heat, the walls should always be double, having on the inside a thin layer of brick, with an interval of one or two inches from the outer and thicker layer of brick or stone, to which it must be united by proper binders. The porous structure of the bricks, added to the impermeableness of the intermediate stratum of air, would so ill conduct heat, that such walls would necessarily tend to keep a house dry and warm in the winter, as well as cool in the summer. This end would be still further promoted by filling the interval between the two layers with dry sand, fresh sifted coal-ashes, or powdered charcoal. In fact, when the common external means before described have succeeded in curing dampness, it has been either by affording a varnish, which has diminished evaporation by preventing absorption, or by increasing the space or changing the quality of the materials of the wall through which the heat was to pass, so as in either of these cases to retain it more forcibly: And when the dampness has been remedied by removing the paper to some distance from the wall by means of strained canvass, that effect has been produced by rendering the paper a worse conductor of heat; and therefore indisposing it to condense the vapour in the room so readily as when it was in contact with the colder wall.

It has been suggested, that it would be possible to keep out cold, or, in more accurate language, prevent the egress of heat from the inside of a room, and therefore from the walls surrounding it, by shutting it closely up, and preventing any admission of the cold external air. This has arisen from the supposition that air is not a good conductor or transmitter of heat through its substance or pores, but that it merely carries it by changing place with some other portion which was less charged with it. If there were no other mode of abstracting the heat from the walls of a room, and if it were possible wholly to prevent any change of its air, this theory might perhaps apply. But it is not possible to prevent some exchange of this kind through the atmosphere of any habitable chamber; and it is evident from the moisture being most abundantly, or perhaps solely, deposited on the inside of that part of the wall which is most exposed to the external cold, that the chief or common mode in which the wall is cooled is not by the access of the cold air into the room, but by the passage of heat from the wall itself into the cold air without. We may however so far avail ourselves of this principle, as to exclude as much cold air as we can, by shutting up the windows and chimnies of uninhabited rooms during the severity of frost.

It may farther be suggested, that as, during a thaw, the air, being warmer than in frost, has a greater quantity of water in form of vapour mixed with it, shutting up a room on such occasions may, by retarding the admission of warmer air so charged with vapour, allow time for the walls to acquire an equable temperature through their substance from without, so as to anticipate any condensation on their surface which might occur from the free admission of the external air. To this I only answer, as before, that rooms according to the common construction cannot be excluded from communication with the external air; and that, in fact, the dampness does under these circumstances take place, though the doors and windows are never opened.

In all cases, however, there is one method of preventing this species of dampness, which is infallible; and that is to keep every part of the internal surface of the wall in the chamber or staircase sufficiently warm by good fires. With this view all staircases ought to have some means of receiving artificial warmth.

If, notwithstanding this and the former precaution, a wall should accidentally become damp, the next best expedient is to dry it as quickly as possible by a free current of warm air.

This discussion, which at first sight might appear tedious and irrelevant, will, I trust, no longer be thought so, when it shall have been found necessary for the establishment of a principle on the subject more immediately before us.

In order to show the analogy, let us take the simplest example, which is that of a wainscotted room, unwarmed by fires. . When the wainscot is colder than the air, it condenses the vapour in form of moisture. If that moisture were exposed to the influence of the sun and wind, the case would come under the former head of decay, which is that of wood wetted by rain in the open air. The water soon evaporates, and little decay proceeds in the wood. So in the wainscot, the surface next the room, though unprotected by paint, will perhaps be long in rotting, because the room admits of currents of air, more especially when doors and windows are frequently opened, so as to evaporate the superficial moisture, though less quickly and effectually than in the open air. But what is the case with the surface of the pannel next the wall? The air, loaded with moisture, penetrates into that interstitial space, and deposits it by condensation on that surface. But there is afterward no current of air to evaporate the water so deposited, which then slowly decomposes and destroys that surface of the pannel. Such is precisely the process of the dry rot, which always begins next the wall, and gradually proceeds to the painted or outer surface of the wood. It resembles in its chief circumstances the decay of paper in a damp room; and it precisely resembles that of paper projecting from the wall on canvass, which will still often happen, if the wall be subject to acquire a very considerable degree of coldness, though much more slowly than in the former case.

The same process obtains in all other cases. Whenever the wood is cooler than the air which it touches, the vapour is condensed upon it; and being exposed to no new heat or current of air sufficient again to evaporate it, remains till another fit of condensation affords a new supply.

Thus the process of corrosion and decomposition is continually supported till the wood moulders away.

The term dry-rot is, therefore, so far from being expressive of the real fact, that decay proceeds under these circumstances more quickly than in the open air, precisely because the wood is more constantly and uniformly wet; just as the lower parts of posts and rails, and any cavities in timber exposed to the weather, rot sooner than those parts which readily and speedily dry.

The smell which we perceive on going into vaults or cellars, where this process is going on, arises partly from the extrication of certain gases, mingled perhaps with some volatile oil, and partly from the effluvia of those vegetable substances, which have already been said to grow on it; and which, though they begin merely because the decayed wood is their proper soil, yet afterward tend probably to the more speedy decomposition of the wood itself. They cannot, however, with more propriety be said to be the cause of the dry-rot, than the white clover, which appears on certain lands after a top-dressing of coal-ashes, can be said to have produced the soil on which it flourished.

I have remarked above, that sometimes only a particular sort or sample of timber has in certain situations rotted, while another piece has continued for a great length of time perfectly sound. Hence persons have been deceived, and been disposed to attribute the dry-rot solely and universally to some original peculiarity in the wood itself. Dr. Darwin explains this fact by telling us, that the wood so decaying has probably been cut in the spring, when the sap in the alburnum was not only abundant, but of a saccharine quality; which, in combination with the vegeto-animal substance or gluten, disposes it to run with unusual readiness into destructive fermentation. In some trees, as by more particular custom the oak, the bark is a very valuable article of commerce, and is found not only to quit the tree more readily, but to contain a larger proportion of tan in the spring, when the sap is rising, than at other seasons. Hence an old act of Parliament, now in force, ordains that all oak, except for the purpose of building, shall be felled in the spring. Whether doors, posts and rails, paling, barrel staves, &c. come under the denomination of building, it may be difficult to say; but it seems at first view highly to be lamented, that any law should impose an obligation to destroy a valuable species of property. It would indeed be matter of peculiar regret, if an impolitic and avaricious spirit should induce the owners of oak forests to extend the same principle to the timber employed in the construction of great machines, and more especially the British navy.

Various means have been employed in order to remove the tendency to the dry-rot in trees so felled. Thus they have been long exposed to the rain, or steeped, or even sometimes boiled in water, and then dried by artificial heat. These means do not however appear to have been successful in entirely washing out the fermentible sap, which therefore makes them much more subject to the decay of which we are treating. It may however still be doubted, whether it acts in any other way than by furnishing a disposition, which requires to be called into action by the same cause which operates in all other cases, moisture.

In proof of what I have stated, I have been informed by one of our vice presidents, that in a large vat or set of vats for beer, belonging to him, the staves formed of oak two inches and a half thick, notwithstanding they were previously steeped in hot water, and then thoroughly dried, in a very short time underwent the dry rot, while others in the same situation continued unchanged five or ten times that period. It is highly worthy of remark, that the outside of these staves, which was painted, continued sound, and that the decay began on the inside, where, from the vats being at different times more or less filled, they were snbject to the joint and successive influence of moisture and air.

I have mentioned above, that the putrefactive fermentation cannot take place except in certain temperatures, the lowest of which, according to Thomson, must be but little below 45 degrees of Fahrenheit's thermometer, and the highest within the degree which produces dryness, by evaporation. The temperature most conducive to this effect has not, so far as I know, been ascertained, though much useful information on this head might be obtained from a set of well conducted experiments.

The following then appears to be the whole theory of the dry-rot; that it is a more or less rapid decomposition of the substance of wood, from moisture deposited on it by condensation, to the action of which it is more disposed in certain situations than in others; and that this moisture operates most quickly on wood which most abounds with the saccharine or fermentible principles of the sap. Let us see how this theory corresponds with the best known means of prevention, and what more effectual measures it may suggest.

The first point is certainly to choose timber properly felled and well dried. And here, in order to prevent the injudicious fall of large oak timber, it may be of some consequence to know, that the bark of such timber contains much less tan than that of the younger and more succulent wood; and that this principle, together with the proper extractive matter, is considerably more abundant in the bark of the Leicester or Huntingdon willow, than in that of any oak. According to the experiments of Mr. Davy, seven pounds and a half of the former will go as far in tanning leather as nine or ten pounds of the latter. It has however been asserted, that if an oak, or any other tree, which is stripped of its bark, be suffered to stand two or three years before it is felled, the wood will have acquired a very great degree of strength and durability.

Next, where it is practicable, a current of air should be frequently made to pass along the surface of the wood. This expedient seems to have been particularly attended to by the ingenious architects of our Gothic churches, who are said with that view to have left various openings in the walls between the two roofs of those edifices. In order also to promote evaporation, a certain degree of heat, such as that of air heated by the sun or fire, should, if possible, be from time to time applied. Cellars themselves ought to have some communication with the outward air by means of windows and shutters, or trapdoors. And that these may be for a short time opened in proper weather, so as to have a draught of air, and that no very low degree of temperature is necessary for the preservation of fermented liquors, provided that temperature be uniform, is evident from the practicability of keeping wine extremely well in cellars which are not damp, and in which, therefore, one or both of these circumstances must have taken place.

The destruction of wainscotting may be long deferred by keeping in the apartment suitable fires.

Lastly, the dry-rot may in all cases be infallibly prevented where it is practicable to cover the surface of the wood, properly dried, with a varnish which is impenetrable and indestructible by water. With this view two or three coats of the composition before described should be laid on the dry wood, before it is erected or put together, and a third or fourth after it is put in its place; and proper means should be taken thoroughly to dry each successive coat of varnish. In situations of this kind, what means of preservation are necessary must be employed at first; as it seems scarcely possible to renew them on fixed timber with any chance of benefit.

I do not know whether in very damp situations, surrounded with stagnant air, these varnishes would in time admit of the growth of fungi or mould. The brimstone might be sufficient to preclude that effect; but, if we believe Braconnot, seeds of the white mustard sown in pure flowers of brimstone, and well watered, became vigorous plants, which flowered and produced effective seed. It is certain, however, that the essential oil of turpentine will act as a poison on growing vegetables; and perhaps the same property may exist in resin, which seems to be a similar essential oil, united with a certain proportion of oxigen.

It is however highly probable, that the union of the brimstone may have another good effect, which is to prevent one of the causes of the destruction of timber which I have before mentioned, the depredations of insects. Whoever would learn the havoc, which certain animals of this kind are capable of making in hot countries, would do well to read Smeathman's description of the termes, or white ant, originally published in the Philosophical Transactions, and thence abridged into the English Encyclopedia Britannica, and other collections. In this country we know little of such ravages. Mischief however of this kind does sometimes occur, and may be the work of various animals, a particular account of which may be met with in the fifth volume of the Transactions of the Linnæan Society.

I am informed, that in India, a circle of lord Dundonald's coal tar drawn on the floor round boxes and other furniture, will effectually preserve them and their contents from the depredations of the white ant.

It appears, that most insects are fond of sugar and mucilage; which is the probable reason why that wood is most subject to be penetrated by worms, which is felled when it most abounds with sap. In such cases, it might be well to try the effects of washing the wood, previously to the use of the varnish, with a solution of arsenic in hot water, in the proportion of one pound to ten gallons; or with a strong decoction of coloquintida or bitter apple, or white hellebore; after which the wood must be completely dried before the application of the varnish in the manner before directed. All these preparations are extremely cheap, and are either destructive or offensive to insects, and therefore will, probably, be an effectual defence against any injury from that cause.

C. H. Parry.

Circus, September 30, 1807.

No. 65.

On the Edulcoration of Fish-Oil. By Robert Dossie, *Esquire.**

Explanation of the Principles on which the Purification of Fish-Oil may be performed, and of the Uses to which it is applicable.

THAT the fœtid smell of fish-oil is chiefly owing to putrefaction, it is unnecessary to show; but, though this be the principal cause, there is another likewise, which is, ustion, or burning the oil, occasioned by the strong heat employed for the extracting it from the blubber of the larger fish, and which produces a strong empyreumatic scent that is not always to be equally removed by the same means as the putrid smell, but remains sometimes very prevalent after that is taken away.

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* Tilloch, vol. 15, p. 105. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. xx.—So far back as the year 1761 the Society voted him a bounty of one hundred pounds for this communication, though they did not publish it till 1802.

In order to the perfect edulcoration of oils there are consequently two kinds of fœtor or stink to be removed; viz. the putrid, and the empyreumatic: and the same means do not always equally avail against both.

The putrid smell of fish-oil is of two kinds: the rancid, which is peculiar to oils; and the common putrid smell, which is the general effect of the putrefaction of animal fluids, or of the vascular solids, when commixed with aqueous fluids.

Fish-oil has not only rancidity, or the first kind of putrid smells peculiar to oils, but also the second or general kinds; as the oil, for the most part, is commixed with the gelatinous humour common to all animals, and some kinds with a proportion of the bile likewise; and those humours putrefying combine their putrid scent with the rancidity of the oil, and, in cases where great heat has been used, with that and the empyreuma also.

The reason of the presence of the gelatinous fluid in fish-oil is this: that the blubber, which consists partly of adipose vesicles, and partly of the membrana cellulosa, which contains the gelatinous fluid, is, for the most part, kept a considerable time before the oil is separated from it, either from the want of convenient opportunities to extract the oil, or in order to the obtaining a larger proportion; as the putrid effervescence which then comes on, rupturing the vesicles, makes the blubber yield a greater quantity of oil than could be extracted before such change was produced; and the vesicles of the tela cellulosa, containing the gelatinous matter, being also burst from the same cause, such matter being then rendered saponaceous by the putrefaction, a part of it mixes intimately with the oil, and constitutes it a compound of the proper oleaginous parts and this heterogeneous fluid.

The presence of the bile in fish-oil is occasioned by its being, in many cases, extracted from the liver of the fish; which is not to be so profitably done by other means as by putrefaction; and the bile being consequently discharged, together with the oil from the vessels of the liver containing them, combines with it, both from the original saponaceous property of bile, and from that which it acquires by putrefaction.

This holds good particularly of the cod-oil, or common train, brought from Newfoundland, which, from its high yellow colour, viscid consistence, and repugnance to burning well in lamps, manifests sensibly the presence of bile and the gelatinous fluid; which latter, by the saponaceous power of the bile, is commixed in a greater proportion in this than in any other kind of fish-oil.

A tendency to putrefy, or at most but in an extremely slow manner, is not an absolute property of perfect oils in a simple or pure state, but it is a relative property dependent upon their accidental contact or commixture with the aqueous fluid. This is evident from the case of oils concreted into a sebaceous form; which being perfectly oleaginous and uncombined with any water, except such as enters into their component parts, will not putrefy unless water, or something containing it, is brought into contact with them. But the fluid animal and most vegetable oils being compounded of perfect oils with other mixed substances, either sub-oleaginous or gelatinous, have always a putrescence *per se*, or tendency to putrefy, without further admixture of aqueous moisture. This commixture of heterogeneous matter in fish-oil, particularly of the gelatinous fluid and bile, gives rise to a further principle of purification than *simple edulcoration*, or the removing the fœtor: for the presence of such humours in the oil renders it subject to a second putrescence *per se*, supposing the first corrected; makes it unfit for the purpose of the woollen manufacture, as the heat through which this is in some cases employed causes this matter to contract a most disagreeable empyreuma. It also prevents its burning in lamps, as well from its viscidity as from the repugnance which the presence of water gives to all oleaginous matter. It is therefore necessary to free the oil from this heterogeneous matter; after which it can be subject only to the rancid putrescence, or that which is proper to oils as such.

The substances which have been or may be applied to the removing or preventing the effects of putrescence, are, acids, alkalies, metallic calces, neutral salts, ethereal and essential oils, vinous spirits, water, and air. With respect to acids, though they may be applied with effect to the removal or prevention of putrefaction in mixed animal and vegetable substances, yet they have not the same efficacy when employed in the case of oils; for in a small proportion, without the subsequent aid of alkalies, they rather increase than diminish the fœtor, and in a large proportion they coagulate the oils, and change their other properties as well as their consistence. Though they might therefore be employed with the assistance of alkalies, yet, requiring a more expensive and complex process, and not being moreover necessary, as the same end may be obtained by the use of alkalies only, they may be deemed improper for the purification of animal oils for commercial purposes. Alkaline substances, both salts and earths, are the most powerful instruments in the edulcoration of oils; but as their action on putrid oils, and the method of applying them to this end, are not the same in both, it is proper to consider them distinctly.

Of alkaline salts it is the fixed kind only which are proper to be used for the edulcoration of oils. Fixed alkaline salts, in a dissolved state, being commixed with putrefying animal substances, appear to combine with the putrid matter, and, mixing with some of the principles, form instantly volatile alkaline salts. On the less putrid they seem to act, after their combination, by an acceleration of the putrescent action, till they attain the degree which produces volatile salts. This is evident by the sensible putrid ferment and smell which appear after their commixture; but which gradually abating, the oil is rendered sweeter, much lighter coloured, and thinner.

Their great use in the edulcoration of fish-oil arises therefore from their converting such parts of the gelatinous fluid and bile as are highly putrefied instantly into volatile salts, and causing a rapid putrefaction of the other parts; by which means the oil is freed from them by their dissipation. They do not, however, equally act on the parts of the oil on which the empyreumatic scent depends, unless by the assistance of heat: for when they are commixed with the oils without heat, in proportion as the putrid smell diminishes, that becomes more sensibly prevalent. The ultimate action of lixiviate salts on animal oils, except with respect to the empyreuma, seems to be the same either with or without the medium of heat; for the same urinous and putrid smell, gradual diminution of the colour, and fœtid scent, happens in one case as in the other, except with regard to the acceleration of the changes; and such salts, where the purification is required to be made in a great degree, are a necessary means, as they are more effectual than any other substance that can be employed.

The use of lixiviate salts alone is not, however, the most expedient method that can be pursued for the edulcoration of oils, for several reasons. If they be used alone, cold, in the requisite proportions, they coagulate a considerable part of the oil, which will not again separate from them under a very great length of time; and when they have destroyed the putrid scent, a strong bitter empyreumatic smell remains. The same inconvenience, with relation to the coagulation of part of the oil, results when they are used alone with heat. The superaddition of common salt (which resolves the coagulum and counteracts the saponaceous power of the lixiviate salt, by which the oil and water are made to combine) is therefore necessary; and the expense arising from the larger proportion of lixiviate salt requires it to be employed if no other alkali be taken in aid, and renders the junction of alkaline earths with it extremely proper in the edulcoration of oils for commercial uses. Lime has also an edulcorative power on animal oils; but it has also so strong a coagulative action, that the addition of a large proportion of alkaline salts becomes, when it is used, necessary to reduce the concreted oil to a fluid state; and therefore this substance alone is not proper for that purpose. The combination of lixiviate salt with lime, or the solution commonly called soap-lye, has an effectual edulcorative action on fœtid oils; but it makes a troublesome coagulation of part of the oil if no common salt be employed, and must be used in such large proportion, if no alkaline earth be added, as renders the method too expensive.

Lime has a power of combining with and absorbing the putrid parts of the gelatinous fluid and bile when commixed with oil, and effects, either with or without heat, a considerable edulcoration of fœtid oils; but it combines so strongly with them, either cold or hot, that the separation is difficult to be effected even with the addition of brine; and the oil, when a large proportion of it is used, can scarcely be at all brought from its concreted to a fluid state but by an equivalent large proportion of lixiviate salt: the use of lime, therefore, alone is improper, or even in a great proportion with other ingredients. But when only a lesser degree of edulcoration is required, a moderate quantity, conjoined with an equal or greater weight of chalk, which assists its separation from the oil, may, on account of its great cheapness, be employed very advantageously: it will in this case admit of precipitation from the oil by the addition of brine. It may be also expediently used when lixiviate salt is employed with heat for the most perfect purification of oils; for it will in that case give room for the diminishing of the quantity of lixiviate salt, though the proportion be nevertheless so restrained as not to exceed what the proportion of lixiviate salt (just requisite for the edulcoration) can separate from the oil.

Chalk has an absorbing power similar to lime, but in a less degree, on the putrid substance of oil: it does not, however, combine so strongly with the oil as to resist separation in the same manner, and is therefore very proper to be conjoined either with lixiviate salts or lime, as it renders a less quantity of either sufficient, and indeed contributes to the separation of the oil from them.

Magnesia alba, or the alkaline earth, which is the basis of the sal catharticus, and the singular earth which is the basis of alum, both have an edulcorating power on fœtid oils, but like lime, have too strong an attraction with them to be separated so as to admit of the reduction of the oil from the concreted state to which they reduce it; and therefore, as they are not superior in efficacy to lime and chalk, but much dearer or more difficult to be obtained, they may be rejected from the number of ingredients that are proper for the purifying of oils, with a view to commercial advantages.

Sea salt has an antiseptic power on the mixed solid parts of animals; but used alone, or dissolved in water, it does not appear to lessen the putrid fœtor of oils, but, on the contrary, rather increases it. If after their commixture with it they are subjected to heat, it rather depraves than improves the oils; but though by its own immediate action on them it conduces so little to the edulcoration of oils, yet it is a medium for the separation of water and the alkaline substances requisite to be employed to that end. It is of great utility in the edulcorative processes; for when alkaline salts or earths combine with the water necessary to their action on the oils, or themselves form coagulums or corrections with it, a solution of salt will loosen the bond and dissolve the close union; so that the oil being separated will float on the aqueous fluid, while the earth, if any be in the mixture, will be precipitated and sink close together to the bottom of the containing vessel.

Sal catharticus, glauber salt, nitrum vitriolatum, tartar, and other neutral salts, though they counteract putrefaction in the mixed or solid parts of animals, seem to have little effect on oils with respect to their edulcoration, and cannot therefore be ranked amongst the substances proper to be used for that purpose.

Lead reduced to the state of a calx, either in the form of minium or litharge, has a strong edulcorative power on fœtid oils, and is indeed applied to that end, with respect to one kind of vegetable oil, for a very bad purpose, considering its malignant qualities on the human body.

In the case of train-oil, which will scarcely ever be considered among the esculent kinds in this country, the same objection against its use would not lie; and employed either with or without heat, it is a powerful absorbent both of the putrid and empyreumatic parts that occasion the fœtor.

As, however, there may be some prejudice against its use even in any way, and as it is not absolutely necessary, I have not given it a place among the ingredients of the processes I recommend.

The ochrous earth of iron, commonly called red ochre, has an absorbing power on the putrid parts of oil, but combines so strongly that the separation is tedious even with the addition of brine: if, nevertheless, it is added when chalk and lime have been some time commixed with the oil, as in process the first, it will promote the edulcorative intention, and will subside along with them; and, as it has some advantage without increasing the expense, unless in the most inconsiderable degree, its use may be expediently admitted in that process.

Essential and ethereal oils are applicable to the prevention of putrefaction in the mixed and solid parts of vegetables, but are not so to the edulcoration of fœtid oils; and if they had the desired effect, they would not, on account of their price, answer the commercial end, unless the due effect was produced by adding them to the oils in a very small quantity.

The same holds good of spirits of wine as of essential and ethereal oils, both with respect to their efficacy and the expense.

Water has an edulcorative action on fœtid oils by carrying off the most putrid parts of the gelatinous fluid or bile, in which, as was above explained, the principal fœtor resides, if the quantity added be large, and an intimate commixture be made of them by stirring them together for a considerable time: this only partially removing those heterogeneous putrescent substances, the remaining part soon acquires the same state, and the oil again grows fœtid, though not to the same degree as before.

Water is, however, a necessary medium for the action of salts and the separation of alkaline earths and calces of metals when they are employed for the edulcoration of oils, as will appear from a consideration of my processes.

Air edulcorates oil by carrying off the most putrid parts, which are necessarily extremely volatile. It may be made to act on them either by simple exposure of them to it with a large extent of surface, or by forcing it through them by means of ventilators, as has been practised by some dealers; but is now, I believe, neglected on account of their finding the improvement of oils by it not adequate to the trouble, as the gelatinous matter and bile, not reduced to a certain degree of putrefaction, being left behind, putrefy again to nearly the same degree as before.

It appears from these several observations, that the cheapest ingredients which can be used for the edulcoration of train-oils are lime and chalk, which may, with the addition of a proper quantity of solution of sea salt or brine, be made to procure a separation of them from the oils, according to process the first, so as to answer for some purposes; that the lixiviate salt is the most powerful purifier of oils, and, with the assistance of chalk and brine, will, without heat, according to process the second, effect a very considerable degree of edulcoration; and that lixiviate salt used with heat, with the addition of lime and chalk, to save a part of the quantity which would otherwise be necessary, and of brine to procure a quick separation, will perform an edulcoration sufficient for all commercial purposes, according to process the third; but that calcined lead and the ochrous earth of iron may, perhaps, be applied in some cases with advantage, where the oil is not designed for esculent use.

PROCESS THE FIRST.

For Purifying Fish-Oil in a moderate Degree, and at a very little Expense.

TAKE an ounce of chalk in powder, and half an ounce of lime slaked by exposure to the air; put them into a gallon of stinking oil, and, having mixed them well together by stirring, add half a pint of water, and mix that also with them by the same means. When they have stood an hour or two, repeat the stirring, and continue the same treatment at convenient intervals for two or three days; after which superadd a pint and a half of water in which an ounce of salt is dissolved, and mix them as the other ingredients, repeating the stirring, as before, for a day or two. Let the whole then stand at rest, and the water will sink below the oil, and the chalk subside in it to the bottom of the vessel. The oil will become clear, be of a lighter colour, and have considerably less smell; but will not be purified in a manner equal to what is effected by the other processes below given; though, as this is done with the expense of only one ounce of salt, it may be practised advantageously for many purposes, especially as a preparation for the next method, the operation of which will be thereby facilitated.

PROCESS THE SECOND.

To Purify, to a great Degree, Fish-Oil without Heat.

TAKE a gallon of crude stinking oil, or rather such as has been prepared as above mentioned, and add to it an ounce of powdered chalk; stir them well together several times, as in the preceding process, and, after they have been mixed some hours, or a whole day, add an ounce of pearl-ashes dissolved in four ounces of water, and repeat the stirring as before. After they have been so treated for some hours, put in a pint of water in which two ounces of salt are dissolved, and proceed as before: the oil and brine will separate on standing some days, and the oil will be greatly improved both in smell and colour. Where a greater purity is required, the quantity of pearl-ashes must be increased, and the time before the addition of the salt and water prolonged.

If the same operation is repeated several times, diminishing each time the quantity of ingredients one half, the oil may be brought to a very light colour, and rendered equally sweet in smell with the common spermaceti oil.

By this process the cod-oil may be made to burn; and, when it is so putrid as not to be fit for any use, either alone or mixed, it may be so corrected by the first part of the process as to be equal to that commonly sold: but where this process is practised in the case of such putrid oil, use half an ounce of chalk and half an ounce of lime.

PROCESS THE THIRD.

To purify Fish-Oil with the Assistance of Heat, where the greatest Purity is required, and particularly for the Woollen Manufacture.

Take a gallon of crude stinking oil, and mix with it a quarter of an ounce of powdered chalk, a quarter of an ounce of lime slaked in the air, and half a pint of water; stir them together, and, when they have stood some hours, add a pint of water and two ounces of pearl-ashes, and place them over a fire that will just keep them simmering, till the oil appears of a light amber colour, and has lost all smell, except a hot, greasy, soap-like scent.

Then superadd half a pint of water in which an ounce of salt has been dissolved; and having boiled them half an hour, pour them into a proper vessel, and let them stand till the separation of the oil, water, and lime be made, as in the preceding process. Where this operation is performed to prepare oil for the woollen manufacture, the salt may be omitted; but the separation of the lime from the oil will be slower, and a longer boiling will be necessary.

If the oil be required yet more pure, treat it, after it is separated from the water, &c. according to the second process, with an ounce of chalk, a quarter of an ounce of pearl-ashes, and half an ounce of salt.

Observations on Process the First.

THIS process may be performed on any kind of fish or seal-oil that is putrid and stinking, and will improve it in smell, and generally render the colour lighter, if previously dark and brown: it will also conduce to render these oils fitter for burning, which are, in their crude state, faulty in that point; but it will not meliorate them to the full degree they admit of even without heat, and should therefore be practised when only a moderate improvement is required.

Secondly, When the oil is taken off from the dregs and brine, the dregs which swim on the brine should be taken off it also, and put into another vessel of a deep form; and on standing, particularly if fresh water be added and stirred with them, nearly the whole remaining part of the oil will separate from the foulness; or, to save this trouble, the dregs, when taken off, may be put to any future quantity of oil that is to be edulcorated by this method, which will answer the same purpose.

Observations on Process the Third.

First, This is most advantageously performed on train-oil, called vicious whale-oil; and the more putrid and foul it may be, the greater will be the proportionable improvement, especially if there be no mixture of the other kinds of fish-oils, particularly the seal, which do not admit of being edulcorated perfectly by means of heat, but require other methods: but when the vicious oil is pure from admixture of others, however stinking it may be, the bad smell will be removed by this process duly executed, and the brown colour changed to a very light amber; and these qualities will be much more permanent in this than in any crude oil, as it will not, from the degree of purity to which it is brought, be *subject* to putrefy again under a great length of time, whether it be kept open or in close vessels.

The oil in this state will burn away without leaving the least remains of foulness in the lamp; and, being rendered more fluid than before, will go further, when used in the woollen manufacture, than any other kind, and will be much more easily scoured from the wool.

If, nevertheless, there be any branches of the woollen manufacture which require the use of a more thick and unctuous oil, this may be rendered so by the addition of a proper quantity of tallow or fat, of which a certain proportion will perfectly incorporate with the oil, the fluidity and transparency being still preserved, as well as all the other qualities that render it suitable to the intended purpose. This may be most beneficially done by adding a proper quantity of the refuse grease of families, commonly called kitchen stuff, which being put to the oil, when moderately heated, will immediately dissolve in it, and let fall also its impurities or foulness to the bottom of the vessel, and render the purified admixture a considerable saving to the manufacturers.

Secondly, The different qualities and dispositions of different parcels of vicious oil with respect to edulcoration render various proportions necessary of the ingredients to be used. The quantities stated in the above process are the least which will effect the end in general, and frequently greater will be required; but this may always be first tried: and if it be found, after six or eight hours simmering of the mixture, that no gradual improvement is making in the smell and colour, but that the oil continues the same in those particulars, and remains also mixed with the chalk and lime, and in a thick turbid state, a fourth or third part of the first quantity of pearl-ashes should be added, and the simmering continued till the oil be perfect. As the quantity of the water is lessened by the evaporation, it is necessary to make fresh additions from time to time, that there may be always nearly the original proportion.

Thirdly, If it be inconvenient to give the whole time of boiling at once, the fire may be suffered to go out and be rekindled at any distance of time; and if, in such case, a small proportion of pearl-ashes dissolved in water be added, and the mixture several times stirred betwixt the times of boiling, it will facilitate the operation. The time of boiling may be also much shortened, if the chalk, lime, and pearl-ashes, be added for some days before, and the mixture frequently stirred.

PROCESS THE FOURTH,

Which may be practised alone instead of Process the First, as it will edulcorate and purify Fish-Oil to a considerable Degree, so as to answer most Purposes, and for Process the Third, when the whole is performed.

TAKE a gallon of crude stinking oil, and put to it a pint of water poured off from two ounces of lime slaked in the air; let them stand together, and stir them up several times for the first twenty-four hours; then let them stand a day, and the lime-water will sink below the oil, which must be carefully separated from them. Take this oil, if not sufficiently purified for your purpose, and treat it as directed in Process the Third, diminishing the quantity of pearl-ashes to one ounce, and omitting the lime and chalk.*

ROBERT DOSSIE.

No. 67.

On the Purification of Rapeseed Oil. By C. THENARD.†

TO purify oil of rapeseed, mix one hundred parts of the oil with from one and a half to two parts of sulphuric acid, and stir the mixture. The oil will immediately change its colour; it will become turbid and assume a blackish-green tint, and at the end of three quarters of an hour it will be full of flakes. You must then give over stirring it, and add gradually double its weight of water to remove the sulphuric acid, which, if allowed to remain too long with the oil, would not fail to exercise too strong an action on it, and to char it. The mixture must then be beat for at least half an hour, to bring the moleculæ of the oil, the acid, and water, into contact with each other; after which it is to be left at rest.

When it has rested about eight days, the oil will float on the surface of the water, and the latter will itself float on a black matter, precipitated from the oil by the sulphuric acid: it is this matter which colours the oil, and prevents it from burning with facility. Three very distinct strata, then, are established, as is here seen: the upper one is oil; the second is aqueous, and contains a little sulphuric acid; and the third is carbonaceous. The oil which forms the upper stratum, after these eight days of rest, is far from being limpid: twenty days, in my opinion, would be necessary for it to purify itself merely by repose; but by filtration it may be immediately obtained perfectly clear and transparent. For this purpose, pounded charcoal, and a piece of linen or cotton cloth, may be employed: the two last substances are preferable to any other. The same cloth will serve several times, only it must be carefully cleaned.

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* The dregs remaining after the sundry processes above mentioned will form an excellent manure, as has been since noticed in Dr. Hunter's Georgical Essays.

† Tilloch, vol. 10, p. 68. From the *Journal de Physique*, Floreal, an. 9.

By following this process with attention, you may obtain oil which has much less colour, odour, and taste, than that commonly used; which will burn with the greatest facility, and without any residuum; and which is equal to the purest oil sold in the shops, &c. The loss is very inconsiderable.

If you are desirous of obtaining it still purer, it may be exposed again to the same treatment; but, in that case, for one hundred parts of oil, one hundredth part of concentrated sulphuric acid will be sufficient. The sulphuric acid will not form in oil which has been once purified a blackish precipitate; on the contrary, it produces a very scanty precipitate, of a grayish-white colour. This precipitate is more difficult to be separated than the former.

When the oil has been treated with two hundredth parts of sulphuric acid, if it be suffered to digest for twenty-four hours with the fourth of its weight of chalk or carbonate of lime, or of argil, you will obtain it almost as clear as water. Lime, however, cannot be employed with advantage, as it would occasion too much waste; but, in my opinion, argil would give very advantageous results: it retains, indeed, a pretty large quantity of oil, but, by means of a press, the last portions of the oil may be extracted from the argil almost entirely.

No. 68.

Plan for an improved Theatre. By Sir GEORGE CAYLEY, *Bart.*[*]

(With an engraving.)

Brompton, September 25, 1808.

SIR—Since the lamentable accident, that has so lately happened to the Covent Garden Theatre, the frequent occurrence of that event to my thoughts has led me to speculate upon the various improvements, that might be made in the construction of theatres. I have taken the liberty of enclosing you the following plan and hints, which I conceive to be worthy your attention, inasmuch as they state undoubted principles, which local convenience may more or less permit to be put in practice, but without an attention to which no theatre can be pronounced well constructed. The science of acoustics is perfectly well understood, and the enclosed rough sketch of the internal plan and elevation of a theatre is modified to the principles of that science, in conjunction with giving the greatest possible convenience of sight to the largest number of people the space can contain.

It is the property of an elliptical room, to collect all the sound uttered in one of its foci into the opposite focus by reflection; hence, as the ellipsis is a very beautiful curve, and as it is only the parts of a theatre distant from the stage, that require the aid of reflected sound, I have adopted this figure, as the ground plan, plate 10, fig. 1, will show. Here any voice uttered upon the stage at A would be concentrated at the point B, excepting what is absorbed by entering the side boxes.

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[*] Nicholson, vol. 22, p. 243.

I have drawn the stage semicircular, and on one side arranged the seats concentrical with it. This, I conceive, would be a material benefit to the observers, but it would have this objection, namely, that the seats, if so placed, must rise in steps and have arms to each; hence the necessary allowance of room for the accommodation of the largest persons would be more than necessary for smaller ones; and on no occasion, however pressing, could the advantage be taken of sitting closer.

I have also drawn the scenery in a portion of a circle, which would be a most material advantage, both to the hearing and sight, *if conveniently practicable:* and provided double the height of a scene can be had within the building, it might be managed by suspending the scenes on cords passing over rollers disposed in this form.

In constructing the elevation of a theatre, the first consideration is to economise space, hence in the boxes, as at No. 1, fig. 2, after allowing the seats to rise one foot in five for the purpose of clearing the view from the heads of those below, if a line be drawn to the top of the scenery from the eye of the most backward observer, the bottom of the next tier of boxes must just commence at that line, as exhibited by dots.

As it is advantageous in the metropolis to make theatres more extensive than the direct voice of an actor can fill with ease, it becomes necessary, to call in the aid of reflected sound, and so to distribute the whole voice as may be deemed most important. I have in the enclosed sketch supposed, that (in a theatre where the extreme part of a pit is one hundred and twenty feet from the centre of the stage) the direct voice is sufficient till within one fourth of the extremity of the building. Therefore, the roof is so curved, as to commence its reflection at that point, as may be traced by following the progress of the pulses of sound emitted by the actor at A. One half the roof, as far as C, is allowed to give the sound it receives over this portion of the pit, and the three tiers of boxes. The remaining half of the roof is employed in throwing its sound upon the upper gallery, increasing the density of its reflection as the distance from the stage increases. Although this gallery receives the influence of half the ceiling, yet from the oblique position of it, it will not catch more than half as much sound as the other portion, which is fully required by the distance of the hind part of the gallery, the direct sound being there twenty-five times less dense than in the quarter of the pit next the stage; whereas by the reflection this disproportion will be reduced to about ten times only, and of course it will be as distinctly heard as in the third quarter of the pit.

The ratio of sound in the three front boxes compared with that of the first quarter of the pit, is as one sixteenth to one; this, by the reflection of half the roof will be reduced to about one seventh, hence these parts will hear nearly as well as the centre of the pit. In addition to this, the back of each tier of boxes should be covered so as to give a focus of sound either to the front, middle, or last benches, as thought best, this shown at 1, 2, 3. The two latter were altered from the former by dotted coves. The fronts to the boxes should present reflecting curves, to throw their sound within the fourth region of the pit.

Fig. 3 is a hind view, showing the proper curve of the roof in this position, where the only object is to keep the diverging rays of sound parallel after reflection, and clear of the sides of the boxes.

I think it would not be particularly expensive to have the whole beam and pillar work of the theatre of cast iron; and likewise to make the elliptical part capable of being completely cut off from any fire in the other part of the building, by a jointed sheet iron curtain, to close up the stage every night after performance, or in case of fire, during the play hours. The name of this would be very attractive.

To prevent the bad effect of squeezing from sudden alarms, *no door about a theatre should open inwards,* and the outlets should be as large as possible, and some extra ones easily opened if necessary: a good reservoir of water, and an engine or two on the spot, are precautions too obvious to need an observation. I am, &c.

GEORGE CAYLEY.

To JOHN KEMBLE, Esquire.

NO. 69.

On the Construction of Theatres. By RICHARD LOVELL EDGEWORTH, *Esquire, F. R. S. &c.**

Edgeworthstown, March 6, 1809.

SIR—The public, by the loss of two theatres in one winter, must be anxious about the plans on which those edifices are to be rebuilt; they will not be satisfied with the opinion of a single architect, they will require an open discussion of the principles, and plans upon which a new theatre is to be constructed; this they have a just right to demand, for their lives and properties are at stake. Every family in London might have mourned the loss of some relative, had the play-houses been filled at the time of the accident; and the whole city might have been burned to ashes by either of the conflagrations.

We are to consider not only the loss of lives by the immediate disaster, but also the apprehensions, which the audience must feel for some time to come; and the anxiety, which those who remain at home must suffer during the absence of their friends at the theatre. Nothing should be left to embitter the cup of innocent pleasure, and "assurance should be made doubly sure," where great hazards are run, from no greater motive than the hope of an hour's amusement.

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* Nicholson, vol. 23, p. 129.

Covent-garden playhouse is now rebuilding without any previous appeal to the public, that I have heard of, as to the plan or precautions, that are to be followed in its construction. I know, that some hints were sent on these subjects, which were not even considered, at least not noticed, till after the plan was arranged. Surely it must be infinitely more advantageous to the proprietors and to the nation, that a short delay should take place before a plan is ultimately arranged, than that a new theatre should be opened ten days sooner, or ten days later.

The glaring defect, or to speak more properly, the obvious blunder in the building of Drury-lane theatre, was the introduction of timber as a frame work for bricks and stone; this is a fault common to buildings in London, where the public safety is without hesitation sacrificed to the interests of individuals.—But to construct a wooden theatre is an absurdity too gross, to pass without animadversion. A frame-work of timber, filled with cores of brick or stone, and cased perhaps with brick or plaister, is opened for the reception of the public, who are to run the risk of sudden destruction from a spark of fire, or a snuff of candle, from the fireworks and lightning of comedy and tragedy, of pantomime and farce, without any probable means of escape, or any security, except what a few hogsheads of water in a cistern on the top of the house can afford.—No future prologue at the opening of a new theatre could re-assure the audience upon this subject.

From a view of these considerations I hope it will appear incumbent upon those, who rebuild Drury-lane, to take time for receiving information from every quarter whence it may be expected: instead of hurrying forward to a beginning before they have well considered the end. A remarkable observation made by that great engineer Mr. Smeaton, in his account of the building of the Eddystone lighthouse, should never be forgotten by those who direct, or by those who undertake extensive public works.—"No resolution of the proprietors," says he, "ever conduced more to ultimate success, than their leaving me at liberty *(as to time)*: had they been of the same temper and disposition as by far the greatest part of those who have employed me, both before and since, their language would have been, *Get on, get on, for God's sake get on*, the public is in expectation, get us something speedily, *to show*, that we may gain credit with the public."

Architects and engineers are so nearly connected with each other in the objects of their pursuits, that it would be well both for them and for the public, if every architect were an engineer, and every engineer an architect. That this is not always the case, we have melancholy instances to prove.

There is a society of civil engineers in London, of which sir Joseph Banks is president, consisting of men of undisputed talents and information. Would it not be advisable, to consult this board? No harm could possibly arise from such application, and much good might be the consequence. If in the multitude of counsellors there may be some delay, there is probably much safety.

Having now animadverted upon the steps that should be taken, before any plan is ultimately settled, I shall venture to offer a few hints upon the construction of a theatre. If any thing, which I throw out, should become an object of discussion, I trust that I may have an opportunity of explaining what I propose; and if any thing be adopted from my suggestions, that it may not be followed, without my being acquainted with the mode of execution. Many new attempts fail of their object by the introduction of additional ideas, that appear plausible; or by the omission of small circumstances, that seem in the original plan to be of no material consequence.

In building a theatre,

1. Security to the audience is the first and most necessary object.

2. Facility of ingress and egress.

3. Facility of seeing and hearing.

4. Convenience to the performers.

5. Space for scenes, with proper openings for the machinery.

6. And lastly, expense.

1. *To ensure safety,* common sense points out, that as little timber and as small a portion as possible of combustible materials should be employed. The outside walls should be constructed of stone—the coins of large blocks of stone closely jointed, depending upon their own bearings and not made apparently compact by mortar. Bricks for the internal structure should be made under proper inspection, and not worked hastily up, to fulfil a contract. All the joists, rafters, and principals, and the framework of the partitions should be iron. The frame work of the roof should be of the same metal, with a covering of copper. No plumber should be permitted to exercise his dangerous trade in the construction of any part of the building.

It may at first sight appear, that the substitution of iron for timber must be enormously expensive—and it would be enormous, if scientific care were not taken, to calculate the stress and strength of every part of the structure where iron was to be used, and to frame the material together upon mechanical principles of strength and lightness.

As to the roof, it could no doubt be made lighter and cheaper of iron than of timber at the present price of that material. Cotton mills are frequently floored with hollow bricks, which are light; and these may be covered with carpetting.

Many other parts of the theatre might be constructed of iron and copper; and stucco might be introduced in many places instead of wood. There are kinds of timber that do not flame; these, though not very durable, might be employed for floors and benches. And where deal is absolutely necessary, it may be covered or imbued with a wash, that in some degree will retard inflammation. After the wood work that requires painting has received two coats of oil paint, it may be finished with a coat in distemper, which may frequently be renewed at small expense, and without the disagreeable smell of oil paint.

To heat the green room, dressing rooms, and the withdrawing rooms, steam might be advantageously employed; and the boiler to supply the steam should be so placed, as to serve at a moment's warning, to work a steam engine of force sufficient to draw water at once from the Thames, and to drive it with a strong impulse wherever it should be wanted. This steam engine should be strongly enclosed in a building, to which access on every side could be easily obtained.

2. Some of the theatres at Paris have commodious avenues; but not one theatre in London has been so placed, or so constructed, as to afford tolerable convenience either to the higher or lower class of spectators.

Private property intervenes so much, that it is scarcely to be expected, that any great improvement can be made in this respect, by enlarging the area round the site of the late building.

Whether a more convenient situation might be selected, I do not pretend to know; but a theatre built on the old foundation might be rendered extremely commodious as to its entrances, or *vomitories*, as the ancients called the avenues to their amphitheatres.

If the whole building were raised upon arches of a height sufficient to admit carriages, and if numerous flights of stairs were constructed within the piers which support these arches, the audience might depart commodiously in different directions, without confusion or delay.

The collonades formed by pillars properly disposed, would permit alternate rows of carriages. Company might descend from the boxes almost immediately into their carriages: passages for those who are on foot might be railed off, and rendered secure.

This plan would be attended with considerable expense; but it might be counterbalanced by sparing one of the higher galleries, which lately injured the *audibility* of the performance, without adding much to the profits of the house. Besides it might be so managed, that tickets for the admission of carriages under the *piazzas* should be issued, which would cover the expense of their construction.

3. *Facility of seeing and hearing.*—As to seeing I believe that very little can be said, but what is obvious to every person of common sense; the actors and the spectators have in this respect opposite interests. It is the interest of the actors, to have that part of the house, which contains the audience, as large as possible. On the contrary it must be the wish of the audience, within certain

bounds, to be near the stage; and in all cases, the audience must wish, that every part of the pit, galleries, and boxes, should be equally commodious for seeing. Now in a large theatre this is impossible. To extend the pit and boxes, they must recede from the front of the stage; they cannot be extended in breadth without shutting out the view from the side boxes.

Little inconvenience was felt as to seeing at Drury-lane; but every body, who wished to hear, complained. As to the actors, to make any impression, they were obliged to raise their voices above the natural pitch; to substitute pantomimic gesticulation, in the place of inflections of voice; and to use contortions of features instead of the natural expression of the eyes, and the easy movement of the countenance. It is in vain, that critics inveigh against the bad taste of those, who prefer show, and pantomime, and processions, and dancing, and all that the French call *spectacle:* unless we can hear the sentiments and dialogue, it is useless to write good plays; but all the world loves *spectacle.* Both these tastes should be gratified. Garrick, as I have heard him declare, was always entertained with a pantomime: he told me how many times he had seen Harlequin Fortunatus with delight—the number I forget, however I am sure, that it far exceeded the number of times any mam could hear a good comedy or tragedy. Surely the literary and the visual entertainment of different spectators might be gratified. In the first place, the audience-part of the theatre should be left smaller, and lower, than it was at Drury-lane. Its shape might undoubtedly be improved, by constructing it according to the known laws of acoustics: but this, if rigorously attended to, would contract the space so, as to affect too much the *receipts* of the house.

The area for the stage might be as large as it was formerly; but the scenery should be adjusted so as to contract the stage to reasonable dimensions. To confine the voice, the wings should have leaves, or flaps, hinged to them, so as occasionally to close the space between the wings, leaving sufficient room for exits and entrances. When large objects require admission, these leaves might be turned back, and would then allow the same space as usual between the wings. This would be an additional convenience to the actors, while they stand in waiting to enter on the stage, as it would screen them from the cold. The ceiling of the stage, which at present is made by strips of painted linen hanging perpendicularly, should be made of well varnished iron or copper frames, turning upon centres so as to open at pleasure like venetian window-blinds; and by this means to contract, at will, the opening of the ceiling, and to conduct the voice of the performers towards the audience. The current of air, so as it does not amount to wind, should flow from the stage to the audience. By experiments tried upon sound by sir Thomas Morland and some other members of the Royal Society, it appeared that the propagation of sound was prodigiously obstructed by the assistance or opposition of a slight current of air. We are told by Vitruvius, and Lipsius, that the sound of the actor's voice was increased in a surprising manner by brazen vessels placed under the seats of the audience.

No satisfactory account remains of the manner in which this desirable effect was produced. It would not however be difficult to try experiments on this subject in any one of our theatres when it is vacant.

About forty years ago I happened to go with a friend into a large cockpit at an inn at Towcester. My friend, who was at the opposite side of the pit, appeared to me to speak with a voice uncommonly loud and sonorous.

Upon my inquiring why he spoke in that manner, he said that he had not raised his voice above its ordinary pitch. Upon looking about I perceived a large earthen jar behind me, which proved the cause of this increase of sound: for upon repeated trials the voice of my friend sounded as usual when I stood in any other part of the cockpit, but that in which the vase was placed. To the best of my recollection the jar was about five feet high, and twenty inches in diameter. I remember well, that it rung clearly, but slowly, when struck with the knuckle. By what means, and by what materials, the pulses of sound may be best returned for the purposes we have in view, is a subject for the joint efforts of mathematics and experiment.

Among other expedients pannelling the backs of the boxes with thin elastic plates of brass might be tried.

A saving and advantage would certainly arise in all cases from using iron, or copper, instead of wood; they would not require renewal for many years, and they would be a preservative against fire. The prompter's box might certainly be improved, so as to throw the prompter's voice more distinctly upon the stage, and to prevent its being heard by the audience.

4. *Convenience to performers.* Notwithstanding the reveries of Rousseau, and the declamations of the overrighteous, actors have risen in the estimation of the public. We have seen with rational and sincere pleasure the excellent conduct of many female performers. I consider this reform as highly advantageous to morality, and it becomes a duty in the managers of a theatre, to accommodate the performers with every possible convenience, so that they may enjoy that English word *comfort*, which in all situations of life tends to promote independance and morality.

It is scarcely necessary to add, that pipes to speak through should be laid from the green room to every apartment of the actors.

6. I have left the article of *expense* to the last, because whatever essentially tends to the convenience and gratification of the public will always find sufficient supplies from the liberality of Britain. A small addition to the price of the tickets would amply defray the expense, that would be incurred by any real improvements.

If the united efforts of men of science and men of practice were directed to this object, we might expect to see a theatre superior to any on the continent, adapted both to the purposes of splendid exhibition and of true comedy; where our children might be entertained with the "Forty Thieves," and ourselves with "The Rivals" and the "School for Scandal."

RICHARD LOVELL EDGEWORTH.

To Mr. NICHOLSON.

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NO. 70.

Description of a very simple and cheap Contrivance for making Port Folios of large Dimensions. By the late JAMES MALTON, *Esquire.**

(With an engraving.)

SIR—As I well know the great inconvenience experienced by artists and collectors of prints and drawings, from the want of portfolios of dimensions capable of inclosing large subjects, and as I also well know that the means used by the Society for the Encouragement of Arts, &c. to promulgate knowledge and useful information are earnest as they are extensive, I am induced to lay before that body a port-folio of my construction, which I persuade myself possesses every advantage that can be wished.

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* Nicholson, vol. 9, p. 128. From the *Transactions of the Society for the Encouragement of Arts, &c.* for 1803.

The difficulty, or rather the impossibility of obtaining cases or port-folios, as large as are sometimes requisite, has given rise to many expensive contrivances, to the same end; or large prints, &c. must be kept in rolls, to their almost certain destruction, by frequency of rolling; or at least they are thus exposed to the danger of being crushed by accident. Milled pasteboards, of which port-folios are made, are not manufactured above a certain moderate size: to exceed that size in a port-folio, is an undertaking of no inconsiderable trouble, in pasting, glueing, and pressing them together. On inquiring of Mr. Newman, of Soho-square, (a manufacturer of these articles,) how he managed to make port-folios above the ordinary dimensions, he informed me, it was an undertaking of trouble, and related his having made one for a gentleman, by attaching sixteen of the largest milled boards together; that the materials alone cost five guineas; and that its weight was greater than one man could lift.

My method of construction obviates all disadvantages—weight, expense, and trouble; and port folios of any dimensions may very readily be manufactured by the simple application of two straining-frames, covered on both sides with canvas, and papered; and connected, as all port-folios are, by leather at the back, or with wooden backs, the sides being connected by hinges. Thus a port-folio may be made capable of holding the largest cartoons, maps, and prints; and possessing another great advantage, besides that of not bellying or swagging, when laid against a wall, as those constructed of pasteboard do, to their own destruction, and material injury of the things they contain.

A frame of four feet by three will be strong enough, if made of deal. The stiles are four inches wide by half an inch thick; and they have a middle upright stile of the same width, with angle pieces at the corners, as is shown in the engraving, fig. 1, plate 11. A frame of much greater dimensions may require two middle upright stiles; and, if very large, a middle longitudinal stile, as is shown in the engraving, fig. 2.

If the frames are made of mahogany, they need not exceed three sixteenths of an inch in thickness; but, of whatever wood they are made, it must be well seasoned, or they will warp. A padlock may be applied to such cases, for the protection of their contents.

On this construction I have made two port-folios, one of which I have had in use these ten years. A handsome one, of tolerably large dimensions, I have sent with this paper, for the inspection of the Society. The outer stiles of it are of mahogany, which, beaded, forms the out edge in a neat manner. Its simple formation, its lightness, and its firm flatness, must be obvious to every one; and I am of opinion the Society will obtain the thanks of all collectors and artists (if they think it worthy of insertion in the volume of their Transactions) by making this simple matter publicly known. For my own part, I shall be highly gratified in having contributed to the comfort of artists and collectors, in preserving their valuable researches. I am, &c.

JAMES MALTON.

Norton-street, June 25, 1802.

Reference to the Engraving, Plate 11.

Fig. 1. One of the sides of a frame for a port-folio, the dimensions four feet by three: it may be made of deal or fir wood. The stiles, four inches wide by half an inch thick; the middle upright stile to be of the same width. It should have angle pieces within the corners, to keep them firm.

Fig. 2. Shows a side of another frame, where much larger dimensions are required; it should then have two upright stiles, and a middle longitudinal stile, all within the frame, and angle pieces at the corners. If it is made of mahogany, instead of deal, the stiles may be reduced nearly one-fourth in breadth and thickness; the wood, in either case, should be well seasoned, that it may not be liable to warp.

No. 71.

Account of an improved Sheep-Fold, contrived and constructed by THOMAS PLOWMAN, *Esquire.**

(With an engraving.)

THE model of Mr. Plowman's Sheepfold was forwarded to the Secretary of the Society of Arts last year with a letter describing its properties and construction. It is made on an improved and very simple principle, combining many advantages over the old and expensive method of folding by hurdles; and as the whole fold can be removed with ease at all times, it is found peculiarly useful in feeding off turnips on the land in frosty weather, when hurdles cannot be used; and, as the saving of labour in agriculture is a leading object, he has no doubt of seeing it, in a very few years, generally adopted.

The expense, in the first instance, will exceed that of hurdles, for the same given quantity of sheep; but having had one in use nearly three years, he is satisfied the saving will be very considerable: for, before he adopted this method of folding, he lost from thirty to forty nights folding in the year, owing to the land being hard in dry seasons, such as the two last; which renders folding almost impracticable, as they never can be set without great labour and destruction of hurdles. He is also clearly of opinion, that the stock of sheep will be greatly increased when this method of folding becomes more known; and that it will enable many small farmers to keep from fifty to one hundred sheep, who now are deterred from it, on account of the small quantity of feed they have, not answering to keep a man for that purpose only; but by this plan, they may keep a boy at three shillings or three shillings and sixpence per week, who can attend on one or two hundred sheep, and move the fold himself without any assistance. In heavy gales of wind it frequently happens that hurdles are blown down, and the sheep, of course, being at liberty to range over the crops, do incalculable mischief; which cannot happen with this fold.

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* Nicholson, vol. 12, p. 192. From the *Transactions of the Society for the Encouragement of Arts, &c.*—The Society awarded the gold medal to him for this useful improvement.

In some counties in England, where hogs are folded, great difficulties are experienced for want of stowage, for them to feed off winter tares, &c. as they root up every stake or hurdle; but from having tried the experiment, the inventor is certain his fold will keep them in, and defies their attempts to displace it.

From this drawing, which corresponds with the model, and from the description, it is seen that an astonishing quantity of time is saved; for one man can remove a fold to contain three hundred sheep with ease in five minutes, which, by the old method, frequently takes some hours to accomplish.

Certificates of gentlemen, who use these new folds, were sent to the society, among whom is that of his grace the duke of Bedford.

When the fold is wanted to be used on very hilly ground, it is best to begin at the top, and work it down to the bottom, for the ease of removing it, and then draw it up again with a horse. This, however, the inventor has never had occasion to do; for the land in his county is ploughed in a contrary direction, and the fold is worked in the same course as the ridges. By this mean, the inconvenience is avoided of crossing the furrows, and they are also a guide to keep the fold in a straight direction.

With respect to the sheep getting under, he does not recollect that circumstance to have ever happened, nor does he conceive that any land, which is cultivated can be so uneven as to admit of it.

Description of the Sheepfold.

PLATE 11, fig. 3. Shows one division or part of this fence twenty-one feet long, and three feet eleven inches high, composed of the following parts:

A. A top rail three inches deep and two inches thick. B. The upper bar, three inches deep, and three-quarters inch thick. CC, The two lower bars, four inches by three-quarters of an inch, which, with the upper bar, are morticed through the uprights. DDDD, Which uprights are oak, three inches by two inches. E, the lower bar, three inches by three. F. An upright bar, with the horizontal bars halved into it. GG, two oak uprights, three by two inches.

Fig. 4. Shows the oak uprights GG. H, The axletree, three inches by three, and three feet between the wheels. I, An oak knee, which connects the uprights GG with the axletree, by means of two screws and nuts.

Fig. 5. A plan, in which the axle H is shown with two arms KK at right angles to H, which are made to act as pivots to the wheels, when intended to be moved in a direction at right angles to the bars.

Fig. 6. Is a view of the same parts described in fig. 5. The wheels marked W, in all the figures, are of cast iron, and cost three shillings and sixpence each.

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NO. 72.

Account of an Improvement in Tram Plates for Carriages on Rail Roads. By Mr. CHARLES LE CAAN.*

(With an engraving.)

SIR—I have forwardad to the Society of Arts, &c. a specimen of my new method of laying rails, or tram-plates, on such a plan as has met the entire approbation of those who have seen it, and are acquainted with the principle on which such roads should be formed. Rail roads are daily increasing, from the great advantage they afford to manufactories connected with mines and minerals, and particularly to collieries. They also promote agriculture, by occasioning lime to be procured from places almost inaccessible by any other means, or whence it could be otherwise brought on moderate terms.

I flatter myself, that every improvement on this system will be of national importance. The honour I received last year from the Society of Arts, &c. has stimulated me to submit the present subject to their consideration.

I have also sent a drawing of my method of laying the tram-plates, with an estimate of the saving that will arise to the public, by adopting the said method, with necessary remarks on the principle on which it is founded. The leading rail or tram-plate has neither tenon nor mortice over the plug. The stop-plate terminates the specimen, which stop-plate should go in with some degree of tightness when laid for actual use, but in the present case that force is not necessary, as the wooden blocks, by a carriage of upwards of two hundred miles, may in some small degree be misplaced. I hope any impediment of that nature will be rectified or allowed for. I wish it to be understood, that a stop-rail is intended to be placed at every thirty yards, at which distance any repairs may be made within ten minutes, which by the present mode frequently occupies more than twice that time, exclusive of disturbing in some measure the line of road. By my method, the plates have a certain degree of play, which is absolutely necessary to avoid that breakage, which too frequently takes place when they are fixed with nails and plugs.

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* Nicholson, vol. 22, p. 339. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. 25, p. 87.—Twenty guineas were voted to Mr. Le Caan for this improvement.

The plates which I send have been fixed in stone blocks, and are nearly as rough as when taken from the sand. If I am favoured with any mark of the society's approbation, I shall hold myself bound to transmit such farther communications on this subject as may be required by them, or any person desirous of adopting my plan. I am, &c.

CHARLES LE CAAN.

Llanelly, Carmarthenshire, May 12, 1806.

SIR—I have considered the improvement made by you in the specimen exhibited of a new design of a tram-plate, and am of opinion, that much advantage may be derived to tram roads by the adoption of your plan, in preventing the temptation of stealing the wrought iron nails, with which the plates are usually fastened, and by facilitating the operation of laying down a new tram roads, and repairing of old ones. I am, &c.

J. Vancouver.

To Mr. Le Caan.
Llangennech Park, April 2, 1806.

Sir—Several tram-plates on your new method of fixing without either nail or plug have been cast under my immediate inspection, at Stradey furnace. The same may be made with as much ease as any others now in use, and I conceive they will obviate the many impediments that arise from the irregularity of driving the nails. I have no doubt from my observation of yours, but that they will answer extremely well, and prove less expensive. I am, &c.

J. Lewis.

To Mr. Le Caan.
Stradey Furnace, April 18, 1806.

Certificates were also received from Mr. R. Jones of Swansea, agent to general Ward's colliery; from Mr. James Barnes, who formed the Myther and Carmarthenshire rail road; and Mr. Edward Martin, of Morristen, an eminent colliery, surveyor and planner of rail roads, all testifying the advantage of Mr. Le Caan's invention.

Reference to the Engraving. Plate 11, *Fig.* 7, 8, 9, 10.

The tram-plates, fig. 7 and 8, are fastened by means of a tenon and mortice AB, each having a correspondent bevel, just sufficient to keep the end from rising up, so that the head of one plate confines the end of the other:

by this means, the workmen are obliged to form their road in right lines, and maintain perfect levels, as the mortice and tenon confines them to the required exactness necessary to make a perfect road: curves or any given segment may be formed with the same nicety, by having two bevel rails or plates made for such purposes.

Fig. 8, A side view or longitudinal section of the two plates placed on their stone blocks or sleepers CD, shows two plugs in dotted lines, one bevel, the other perpendicular, cast in the stop-rail or plate, which is so called as it prevents the others from moving, and when taken up releases all those between the stop-plates; twenty-five yards of rail roads made with these plates, may be taken up and replaced within ten minutes. The plugs in dotted lines are shown in their proper positions within the sleepers EFG.

The usual length of a tram-plate is three feet, the flanch or outside edge H, about one inch and half high, the sole or bed I, from three inches and a half to four inches broad, and three fourths of an inch thick; but these dimensions may be varied according to circumstances. The most approved weight has been fourteen pounds to the foot, or forty-two pounds to the plate, the ends from which the plugs project, and to which the tenons and mortices fasten, should be one fourth of an inch thicker than the other part of the plate.

Fig. 9. AB show the under part of the tenon and mortice, and the form of one of the sloping or bevel plugs.

The diameter of the plug near the shoulder is one inch and three quarters, reducing to one inch, its length two inches and a half, forming an angle of eight degrees, the plate from which it projects is counter sunk, so that the shoulder of the plug may not receive any sharp pressure or prevent the plate from having a perfect bearing.

There is a small groove in the whole length of the exterior of each plug, to admit a wire to pass to its extremity, to draw the plug out if broken by any accident, also to admit the expansion of water, in case of severe frost.

The blocks or sleepers, EFG, on which the tram-plates are placed, should by no means be less than one hundred and twenty pounds each in weight, but should be heavier on some kinds of ground: the depth of the hole for the plug should be three inches, and worked according to the inclination of the plug, for which purpose the stone-mason should have a standard cast-iron guage; there should be projections, K, cast with the flanch or outside edge of the tram-plate, as shown at fig. 7, to make the plates lie firm on their sleepers.

Fig. 10, is a section of one of the ends of a tram-plate, in which H shows the flanch or upright edge, I the flat part or sole on which the wheels of the waggons run, D one of the plugs, K the projection behind the flanch to make the plate lie firm on the blocks.

GENERAL OBSERVATIONS.

THE advantages of laying plates on the above principle are obvious; the blocks being put in their places never sink below their intended level, the act of driving either nail or plug, (which requires a considerable degree of force, and too frequently destroys the level of the road,) being here unnecessary. In the common mode of making rail-roads, from the irregularity of nails, particularly in forming their heads, few can be driven exactly even with the plate, and they are perpetually obstructing the passage of the waggon; the workmen frequently not proportioning their holes and plugs to the hole in the block also occasions considerable breakage; the exertion necessary to fix a rail or plate completely is great, and numbers of plates, particularly when the iron is short or brittle, are broken near the mortices by missing the stroke of the hammer, which must be used with great force.

Advantage gained in laying my Tram-Plates in Comparison with other Modes.

	L.	*s.*	*d.*
Nails used in a mile, 3520 of 3 in the pound, at 4*d.* per lb.	19	11	0
Nails lost or defective, computed at per mile	1	0	0
Plugs with their loss	6	5	0
By breakage of rails, average from experience	7	10	0
Lessened by labour in block laying, calculated at only two pence per yard . .	14	13	4
By breakage of blocks	1	0	0
	*L.*49	19	4

This calculation does not take in annual loss of nails, and breakage of blocks, which is considerable.

No. 73.

Description of a Screw Press with an expanding Power.

By Mr. William Bowler.

(With an engraving.)

SIR—The screw and spring-press which I have the honour to present to the inspection and for the approbation of the Society for the Encouragement of Arts, &c. will, I trust, be found in a superior degree adapted to the purpose of pressing bodies in general, but more particularly cheeses, apples, linen, &c. because such things require a firm and unrelaxing pressure:—and this is a peculiar advantage incident to this machine; for after it is set, or the spring screwed well up, it will be found, that as the *article* pressed shrinks from it, so the spring, owing to its peculiar expanding power, gradually follows the object of its pressure, and hence continues to maintain an uniform and equal action on the body on which it is placed. This, in cheese-making, will be found peculiarly advantageous; for it is from this very cause of want of sufficient pressing that cheeses are frequently so very bad. Were the curd entirely separated from the impure and contaminating mixture of the whey, which must be effected by the regular action of this machine, we should always have the cheese firm and wholesome; and, I have not a doubt, the press will be found equally useful in all other cases, and answer every purpose, even beyond expectation, to which it is adapted. I am, &c.

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* Tilloch, vol. 21, p. 249. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. xxi.—A bounty of ten guineas was voted to the author by the Society.

WILLIAM BOWLER.

To CHARLES TAYLOR, Esquire.

Reference to the Engraving. Plate 11, *Fig.* 11.

AA, the two upright sides, or frames of the press.

B, the cross piece which connects them at the top, having a hole in its centre, for the screw.

C, a strong block of wood, into which the two sides of the press are firmly morticed.

D, the box, in which the article to be pressed is placed. This box has a number of holes in its bottom, through which the liquid matter when pressed out passes, and is discharged from the mouth of the spout E, a small hollow being left under the box, to allow its passage to the spout. A loose wooden cover fits into the box D, and upon it is fastened a stout piece of timber F, and an iron plate G, for the point of the screw of the press to act upon.

H, the male screw of the press, working in a female screw in the centre of the strong cross piece I, which cross piece slides up and down in grooves within the two sides of the frame, one of which grooves is shown in the plate, and about half the length of the side piece.

K, the upper part of the iron screw, on which the handle L, which moves it, is placed upon a square. The iron of the screw is only wormed about half its length.

M, a strong spiral spring, made of iron wire, or iron rod, placed in the centre of the cross pieces B and I; this spring presses downwards against the cross piece I, forcing it as low down as the side grooves will permit. The male screw H lies within the circle of this spiral; and, when the screw is turned, passes through the female screw below it, and acts upon the iron plate G, under which the matter to be pressed is placed, by continuing to turn the screw. As it meets with resistance at the point G, it gradually forces back the cross piece I, by means of the female screw within it, and compresses the spiral into a small space, between the two cross pieces, in which state it remains, till the article which is pressed in the box begins to give out a part of its contents. The spiral spring M, compressed as above mentioned, then begins to expand, and exerts a continued re-action upon the cross piece I, on the male screw H, the iron plate of which covers the article under pressure.

Fig. 12, is the male screw, separated from the other parts, to show how far the thread or worm extends upon it.

NO. 74.

Method of Securing the Beams of Ships, without wooden Knees made of one Piece. By Mr. GEORGE WILLIAMS.*

(With an engraving.)

I SUBMIT to you, for the inspection of the Society, the following particulars of my invention for the better securing of the beams of ships of war, East and West India ships, and all others where strength, dispatch, room, and cheapness are required. In this method less iron in weight, and fewer bolts are necessary, than in the iron knees before in use; there is also less strain upon the bolts, as the block underneath is morticed both into the beam and side of the ship, as well as bolted.

Upon this plan the work is all done under the hand, which is executed much quicker than in the former plan, where the work is all done over hand, and where great nicety is requisite in making the bolt-holes which pass through both the iron stays. In my method much more room is also gained between decks for stowage and working the guns, and even a porthole may be made under the beam itself.

I calculate the saving in a 74-gun ship or East Indiaman to be as follows, viz.

	Ton.	Cwt.	qrs.	lbs.		s.	d.		L.	s.	d.
Copper bolts,	2	1	3	9	at	1	4	*per lb.*	305	8	0
Iron,	2	12				56		*per cwt.*	145	12	0
Three men and one boy's time for a month									45	17	6
Timber									50	0	0
									*L*546	17	6

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* Nicholson, vol. 26, p. 187. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. 27, p. 142.—The silver medal was voted to Mr. Williams for this invention.

The models I have sent will, I trust, clearly explain to the Committee every circumstance, which will be thought necessary. I am, &c.

George Williams.

Explanation of the Engraving. Plate 12, Fig. 1, 2, and 3.

Fig. 1 is a horizontal plan of a portion of a ship's side; the planks of the deck being removed, to show the ends of two of the beams AA, which extend across the vessel. BB is the outside planking of the ship; CC the sections of the timbers or ribs; and to these the beams AA are fastened by beaten iron triangular braces *aa*, similar in form to the Roman capital letter A. These are let into the beams, and attached there at the angle by three bolts going through them. Fig. 2 is a front view of only one beam, where the spectator is supposed to be looking towards the ship's side; and fig. 3 is part of a cross section of the vessel's side; the same letters are used as in the other figures. By inspecting these, it will be seen, that the ends of the brace *aa* are turned up and bolted to the timbers of the ship's side by two bolts passing through each end, and through the timbers and the outside planks; by which means the beams are secured from lateral motion: and to brace them in a vertical direction the wooden block H, fig. 3, is fitted in beneath them, and two iron straps bolted on them; one end of each of these straps is attached to the deck beams by the same bolts as the upper brace *aa*; the other ends are bolted against the inside planking, and an oblique bolt *h*, fig. 3, passes through the middle of each strap and the ship's side; *lll*, fig. 1, are the small intermediate beams, answering to the joists of a floor, to which the planks of the deck are spiked down; *m*, fig. 1, represents one of the planks, and the dotted lines show the joints of the others. In fig. 3, these planks are shown, and the other beams to make all sound and firm, which were removed in the other figure to show the braces.

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No. 75.

*Method to prevent the Accidents which frequently happen from the Linchpins of Carriages breaking or coming out. By Mr. J. Varty.**

(With an engraving.)

SIR—Herewith you will receive a model of an axletree for public machines, intended to prevent the wheel from coming off, if the linchpin should break, and thereby prevent many dangerous consequences. When the idea first suggested itself to me, I put it in practice in a stage coach, which has since run from Liverpool to Litchfield, a distance of eighty-four miles, six days per week, for the last six months. During that time several instances have occurred in which the linchpins have broke or come out, but owing to this contrivance no accident has happened therefrom. We almost daily hear of stage coaches being upset, which more frequently arises from linchpins breaking than from any other cause.

In offering this model to the Society of Arts, &c. for their inspection, I anticipate the pleasure of their sanction, as I can furnish satisfactory vouchers of its proved utility. I am, &c.

J. Varty.

Description of the Engraving. Plate 12, Fig. 4, and 5.

Fig. 4 is a section of the nave of a carriage wheel, with the axle-tree AA in it; and fig. 5 is a separate view of the axletree. *a*, fig. 5, is the linchpin detached; it is put through an oblong hole in the axle as usual, but there is likewise an additional linchpin *b*, to make it complete, which is fixed in a recess cut for it in the axle, and turns on a pin (as is shown in the figure) into the hole left by removing the linchpin *a*, when the wheel is to be taken off; but if the linchpin *a* should accidentally get out, this additional pin *b* would effectually keep the wheel on, as its hanging position does not at all tend to shut the pin up into the axle, but the contrary. The common linchpin *a* is put in downwards, and its weight may also tend to keep it in, and is secured in the usual way by a strap, the holes for which may be seen in the figures. The whole, when in its place, is shown at fig. 4.

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* Nicholson, vol. 26, p. 189. From the *Transactions of the Society for the Encouragement of Arts, &c.* vol. 27, p. 145.—For this invention the silver medal was voted to Mr. Varty.

No. 76.

On the Construction of Theatres, so as to render them secure against Fire. By Mr. B. Cook.

SIR—In some former letters you did me the favour to insert in your Journal, I have recommended the use of iron in the place of wood; in my last on that subject I pointed out its use and advantages in substituting it for wood in buildings, but more particularly in adopting it for staircases, as promising a certain escape in case of fire. What I would direct the attention to in this is, the great advantage of employing it almost entirely in the erection of public buildings, especially theatres; and although I am not an admirer and encourager of theatric representations, but, on the contrary, think they are injurious to a state, as contaminating the morals and habits of a people, and consider them as the very seat and emporium of vice and immorality, yet as they are permitted, it is a desirable thing, to have them erected in such a way, that, for safety's sake, the frequenters may not be in danger from any accident or other cause. We have seen the two national theatres destroyed entirely, and that with a rapidity that no human exertion could put a stop to. Their destruction arose no doubt from an unpardonable neglect, or a worse cause: one has risen like a phœnix from its ashes, more beautiful than before, but is it not risen with all the dangers of destruction in itself? It ought to have risen immortal; it ought, as a national establishment, to have been composed of such materials, as would mock a second dreadful devastation. A fire once commenced, would it not, in this new theatre, communicate to all its parts? Would it not put at defiance the power of man to suppress it, and in a few hours would it not again be a heap of ruins? Drury Lane is still in this situation; and as it is in contemplation to raise it to its former splendour, and as another theatre is about to be erected also, I do hope, before they are erected, that the proprietors will carefully consider how absolutely necessary it is to compose them of such materials, as will endure for ages, and that cannot be again consumed with fire. The destruction of Covent Garden was accompanied with the loss of so many lives, that no care or expense can be too much to guard against so dreadful an accident. I mention not the loss the proprietors sustained, I take not that into the scale, for what is the loss of property, when compared with life? The nation ought to superintend the erection of its public buildings, especially those buildings set apart for amusement. The lives of his majesty's subjects ought to be as carefully provided for by the legislature, in their meetings together for amusement, as it provides for them from their enemies from without. I always have considered all such places as extremely dangerous, not that I suppose that a fire could begin and communicate itself round the house with such rapidity as to endanger the lives of the auditors; but what is as bad, or worse, on the first appearance or cry of fire, instantly would the audience rush from their places to the doors, and hundreds of lives would perhaps be lost; for the very idea of a fire deprives a man of that command over his reason, especially if he conceives the danger imminent, that at the first scream of fire, all would press to escape, so that numbers would be suffocated, crushed, or trodden to death. The second view I would take is, that on such immense piles of building being in a blaze, if the wind should be high, vast danger might be the consequence; and in the attempt to extinguish fires of this sort, we have a recent instance in Covent Garden, how dangerous is the employment of the firemen and assistants. I will suppose, that a theatre was constructed of iron instead of wood. If the scenery during the midst of the performance was to take fire, and the whole in a blaze, the spectators might rest quiet, it could not extend to reach them; and I do think, that, although the whole house resounded with the cry of fire, the idea would fix itself on the mind so strongly, that they were sitting on iron, that the alarm would not so much affect them, if it did at all, as to produce any mischievous consequences. The very thought of the theatre being incombustible would draw to it many persons, who, from a fear of accident, might now keep away. The security it promises to the proprietors not only from real danger, but from the alarm of danger, would, I should suppose, (especially if it can be made appear, that it would be erected as cheap, or nearly so, as of wood) induce them to adopt this plan.

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* Nicholson, vol. 25, p. 301.

I will give a brief description of the mode, and although imperfect, yet all I wish is to strike the mind with the idea, and induce the proprietors to give it due considerabeauty and delicacy of its composition, as in iron the finest specimens of antiquity could be introduced. The supports of the galleries should be iron. The gallery floor laid down fire proof, and the seats, if not iron, should be on iron supporters—the gallery stairs and staircase all iron, and the roof should have no wood at all in it, but be composed of hollow or solid iron, cast light, and if each piece was graduated from bottom to top, would still make it more light, and yet be equally as strong. A roof of this description well secured together with screws and bolts, &c. would not be considerably heavier than wood, as the iron would possess strength equal to wood, at less than half the thickness.

Now it would be well to compare the advantages iron promises above wood, before it is adopted; and in looking at its advantages, all its possible disadvantages should be coupled with them, in order to see it in its true point of view. One objection might be urged, that it would be difficult to erect a theatre or great public building on this plan. But I say there would be no difficulty in procuring men competent to undertake the erection of them, and who are able to plan, get made, and put together all, its several parts; and in those parts where there was a field open for genius and taste to show itself, in the entrances, boxes, and other conspicuous parts of the house, the most beautiful and unique ornaments might be made, and finely cast in iron, and afterwards touched up with the tool, and painted to imitate whatever fancy might dictate. There would be, especially in a theatre, the greatest scope for genius; thus might be constructed the most elegant one in the world; and one that no accident, no misfortune, no incendiary could destroy—that would brave the utmost efforts of time to destroy it—that would endure for ages. Another disadvantage might be supposed, and that is the additional expense in the erection. This might be something more, especially if beauty was suffered to lead, and genius permitted to exercise itself in the ornamental part; but suppose it was to cost ten thousand pounds more, what is it, in a public national building? especially when you are certain in constructing it in this way, you are constructing a work that will endure for ages. If you use wood, how can you assure yourselves, but by some unforeseen accident it may meet with the fate of the other theatres? Money must not be put in the scale as a competent balance against security. After considering the subject, and examining the way Covent Garden is built and fitted up, I am more and more convinced in my mind, that iron might be substituted for all the timbers, and for fitting up a theatre complete in the way I have before hinted, as cheap, or nearly so, as though it was done with wood. It is then self evident, it would be more durable, perfectly safe from fire, and much more elegant, if raised under the auspices of a man of genius and good taste. I am, &c.

B. COOK.

Caroline Street, February 20, 1810.

REMARKS.

THAT the construction of theatres is a matter of public concern has already been very justly observed by Mr. Edgeworth, in his paper on this subject,* where too the use of iron and incombustible materials is strongly inculcated. Sir George Cayley likewise, in his paper,† recommends the use of iron, but not to the same extent as Mr. Cook; though certainly the more of it can be employed the better. There is one thing however of which Mr. Cook does not seem to be aware, and that is the necessity for trap doors and openings in the floor that forms the stage: but this is of little consequence, for they might be contrived in a floor of iron, as well as in a floor of wood. To obviate the objection of increased expense, Mr. Cook brings against it the increase of duration, with the probability of larger audiences. But if we likewise take into consideration the saving of insurance, it would probably be found on calculation, that the use of iron would be by much the most economical. This saving, which does not appear to have been adverted to, probably from its amount not being generally known, will be considered as of no small importance, when it is understood, that the offices were paid forty shillings for every hundred pounds insured, previous to the burning down of Drury Lane theatre; and that, since this event, they will not insure at a less premium than four guineas per cent. Now the proprietors of the theatre lately erected at Covent Garden state the expense of erecting it at one hundred and fifty thousand pounds; the insurance of which against fire would amount to no less than six thousand three hundred pounds a year. If, as I suppose, scenery and dresses be not included in this estimate, the insurance would be still more to cover the whole. And to insure only one third of this, or fifty thousand pounds, as on the old theatre, the premium would be two thousand one hundred pounds a year. Would not the saving of such a sum annually more than repay the additional expenditure for rendering the building proof against fire by the general use of iron? to say nothing of other advantages.—NICHOLSON.

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* See this volume of the Emporium, p. 353.

† See page 350 of the Emporium.

NO. 77.

Tools to answer the Purpose of Files and other Instruments, for various Uses, made of Stone-ware. By G. CUMBERLAND, *Esquire.*

SIR—To some men, but not to you, will it appear a trifle, because very obvious on reflection, to have applied so soft a substance as clay to the purpose of lograting the hardest bodies; neither should I perhaps have ever thought of such an application in the form I now use it, had I not found, in shaping of some substances, that the wear of my steel files was rather expensive.

It then first occurred to me, in ranging in thought after a remedy, that, as our stone-ware is so hard as to blunt our files, files might be as well made of our stone ware. This was about two years ago, and the first use I made of this suggestion was, to fold up in muslin, cambrick, and Irish linen, separate pieces of wet clay, forcing them by the pressure of the hand into the interstices of the threads, so as on divesting them of the covering to receive a correct mould. These I had well baked, and immediately found I had procured an intire new species of file, capable even of destroying steel; and very useful indeed in cutting glass, polishing, and rasping wood, ivory, and all sorts of metals.

The ease with which I had accomplished my purpose, as is too often the case, made me content myself with the use of my own discovery, or at most giving away a few specimens as files for ladies nails of peculiar delicacy: but having since reflected, that in glass grinding (the stones for which come from the North, and are very expensive) in flatting metallic mirrors, laying mezzotinto grounds, and a number of operations that require unexpensive friction, these stone-ware graters, if I may so call them, as not being of the exact shape of files, may ultimately become very useful. I take a pleasure in furnishing you with a description of my method of applying this substance, accompanied with a specimen or two of a portable size, that you may the better be able to judge of their value to the arts, which to me the more I reflect on them seem the more important; as in all operations of grinding a great deal of manual labour must first be bestowed on the tool, whereas here we may mould ours in an instant, if we use a press, as in pipe making, and the expense is infinitely inferior to that incurred in constructing even the cheapest file or logrator. I am, &c.

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* Nicholson, vol. 25, p. 257.

G. Cumberland.

To Mr. Nicholson.
Bristol, February 10, 1809.

P. S. I have not yet tried it, not having the means just now at hand, but if a good parabolic reflector were to be impressed with a mass of stone-ware clay covered with muslin, so as to make several casts of different degrees of fineness, we might this way acquire tools, that would greatly lessen the expense of the operation of grinding; but much would depend on care in baking. Our stone ware warps but little ever.

Annotation.

This ingenious invention promises to be of considerable use in the arts. The abrasion of surfaces is performed either by a toothed tool, as in filing, rasping, &c. or by a grinder, in which cutting or hard particles are bedded with considerable firmness in a softer mass; or by scouring, polishing, &c. in which hard particles are more or less slightly retained in a soft or tenacious substance.

Mr. Cumberland's instruments appear to promise great utility in the first and last of these processes; that is, they may be used either with or without a fretting powder. There are however many objections to their being used to grind speculums; not only with regard to the intended figure, but the nature of the material.

WILLIAM NICHOLSON.

No. 78.

Researches respecting the Composition of Enamel. By C. CLOUET, *Associate of the French National Institute.*[*]

WHITE ENAMEL.

WHITE enamel, either for earthen-ware, or the purpose of being applied on metals, is composed in the following manner: You first calcine a mixture of lead and tin, which may be varied in the following proportions; viz. for 100 parts of lead, 15, 20, 30, and even 40 of tin. A mixture of lead and tin calcines very easily in contact with the air. As soon as this mixture is brought to a red heat, nearly a cherry colour, it burns like charcoal, and is calcined very speedily. The composition which calcines best, is that which in 100 pounds of lead contains from 20 to 25 of tin. The tin here meant is pure tin. In proportion as the calcination is effected, you must take out the calcined part, and continue to oxydate the rest until the whole has become pulverulent. As some small particles always escape calcination, you must expose to the fire a second time the oxyd obtained in order to calcine it completely; which may be easily known by its ceasing to sparkle; that is to say, when you no longer see any parts burn like coal, and when the whole appears of an uniform colour. When the proportion of tin exceeds 25 or 30, a stronger fire is necessary to produce the calcination. In a word, by varying the degrees of heat you will be able to discover that best suited to the mixture on which you operate.

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[*] Tilloch, vol. 7, p. 3. From the *Annales de Chimie.*

A hundred parts of the calx above mentioned, which in the French potteries is called *calcine*, is generally taken with 100 parts of sand. From 25 to 30 pounds of sea-salt, or muriat of soda, are added: the whole is well mixed together, and it is fused in the bottom of a furnace in which potter's ware is baked. This matter is generally placed on sand, on lime quenched in the open air, or on ashes. The bottom of the mass is in general badly fused. This, however, does not prevent the matter, after it has been pounded, and applied on the articles, from becoming exceedingly white and hard in the furnace. When taken from the furnace it is not white; it is even often very black: in general it is marbled with black, gray, and white.

This process is that generally used in potteries. In the compositions destined for earthen-ware, the proportion of 25 parts of tin to 100 of lead is never exceeded: for common earthen-ware, the manufacturers are even satisfied with 15 of tin to 100 of lead. It may be easily seen, that if you wish to obtain an enamel whiter and more fusible, you must diminish the quantity of sand; but there is no necessity for augmenting that of the sea-salt, or muriat of soda: as the whiteness and opacity depend on the quantity of tin, you may use *calcine*, which contains 25 or 30 per cent. For example, 100 of such calcine, 60 of sand, and 25 of marine salt, give a composition exceedingly fusible.

But it is to be observed, that it is necessary to employ some further manipulations when you wish to have enamel proper for being applied on metal, and are desirous to give it all the perfection of which it is susceptible. In that case, you do not employ crude sand, but calcine it, in a strong heat, with a quarter of its weight of marine salt, either in a small quantity in a crucible, or on a large scale in a potter's furnace. If you wish to have a very fusible enamel, you may even add minium, or lead calcined by the former operation, and nearly as much sea-salt, that is to say, a fourth. You then obtain a white mass half fused and porous, which you pulverise, and employ in the composition of enamel instead of sand, and in the same proportions as sand: you may even diminish the quantity of this matter to 50 per cent, if you are desirous to obtain an enamel very fusible. This will depend also on the *calcine* employed; for that which is most charged with tin is the least fusible.

When you wish to have fluxes for the colours, you employ the same compositions before mentioned, except that you put little or no tin into the lead. In the latter case you must generally employ minium. This flux is good for certain colours, but not for all. There are some which become tarnished by fluxes, that contain the oxyds of lead. In that case, you must make fluxes without oxyd of lead. Nitre and borax are generally used for making this glass, but you add no calx of tin. The following are those which I have tried:

Three parts of siliceous sand, one of chalk, and three of calcined borax, give a matter proper to be used as a flux for purples, blues, and other delicate colours.

Three parts of white or flint glass, one of calcined borax, a quarter of a part of nitre, one of the white oxyd of antimony made with nitre well washed, give an exceedingly white enamel, which may serve also as a flux for purple, and particularly for blue.

Sixty parts of enamel sand or less, thirty of alum, thirty-five of sea-salt, and a hundred of minium, or any other oxyd of lead, give a white enamel when the fluxes do not predominate too much, and a gelatinous glass when a great deal of fluxes has been added. This glass is good for red, and the enamel may be applied to all kinds of clay capable of sustaining a strong heat.

It is of great importance to remark, and to know, that the sand employed for enamel must not be sand which contains only silex: sand of that kind alone is of no use. The sand proper for this purpose is that which contains talc with silex. To make a sand proper for enamel and the fluxes of colours, &c. there must be nearly one part of talc and three of siliceous sand.

What appears to me most essential in regard to the success of enamel, is the choice of sand. It is very possible to compose this sand by art; and though I have not decomposed it, I have found by synthesis, that three parts of siliceous sand and one of talc form an excellent sand for enamel. From this it may be readily seen, that, to compose with facility sand for enamel, nothing is necessary but to determine, by a good analysis, the quantity of talc. This sand may be procured in places where earthen-ware is made. It may be easily known; for, besides the siliceous sand, which forms the greatest part of it, you may observe in it talcky particles in great abundance; and, to be good, it must contain nearly a quarter. When it does not contain a sufficient quantity, the enamel it produces fuses with more difficulty, and does not become smooth; it remains granulated and pitted. There are certainly some combinations of earth which may produce very good fluxes, either for enamel or for transparent colours. It might be attended with advantage to try some of these combinations. Ponderous earth (barytes) and lime fuse very well together: by adding a little silex, or a little magnesia, it is probable that an excellent matter might be produced. If this glass, composed of lime and barytes only, had sufficient solidity to resist the air and weak acids, there would be no necessity perhaps to add silex; but if the marine salt, as I am inclined to think, ought also to enter into the composition of this kind of glass, silex ought likewise to form a part of it. The experiments on this head, for the sake of trial, may be varied different ways. When the glass destined to serve as flux for colours is employed, it is customary, in order that they may be rendered more fusible, to add a little nitre and borax. The common borax of the shops contains an excess of soda, which, in my opinion, it would be of benefit to saturate with the nitric acid. I think also that the flux might be rebaked with the dose of nitre and borax, or of nitric borax, which might be added before being employed. It is only to colours such as purple and the oxyd of cobalt that nitre and borax are added.

I have tried to find a substitute for marine salt in the composition of white enamel. Potash produced only an ugly and ill fused gray mass, which acquired no lustre in the furnace; nitre produced a green mass, but exceedingly friable; sulphat of potash produced very nearly the same effect, only the mass was a little whiter: but neither of these enamels was worth any thing. I did not try pure soda: I have, however, heard common soda extolled; but as it contains a great deal of marine salt, it must undoubtedly be on account of this salt that it produces a good effect. Pure soda may nevertheless be tried, either alone or with marine salt; it perhaps might produce no bad effect with potash.

I have tried also a mixture of equal parts of lime and argil, to which I added one part of silex, and likewise without silex; but this mixture did not supply the place of talcky sand. This sand is not in general found in grains; it exhibits itself most commonly under the form of a stone, such as free-stone; but some of it is found also in grains.

We should be much deceived in making white enamel were we to employ the oxyds of tin and lead separately, as I have read in all the authors I could find who treat on the art of pottery. None of them say what they ought respecting enamel, nor even respecting the composition or nature of the earth proper for bearing an enamel.

It is essential that the lead and tin for making the oxyd employed to produce white enamel, should be fused and mixed together before they are calcined; and if you wish that the enamel should immediately acquire its full whiteness, it will be necessary that the calcination should be complete.

Bismuth might perhaps be employed as a substitute for the lead, and it is not improbable that it would give a good effect. Bismuth also might be mixed with the lead in the following manner; namely, one part of lead, one of bismuth, and one of tin: or other proportions might be employed; but I have not tried any others. As the oxyd of bismuth, however, is exceedingly fusible, I think it might be admitted, with great advantage, into certain fluxes. I have not tried what might be produced by the white calx of zinc, nor by that of tin, made by dissolving it in the nitric acid or by detonation with nitre. A mixture of lead and tin, detonated with nitre, would be useful. Though the white calx of regulus of antimony made by nitre, and well washed, (diaphoretic antimony,) produces a very beautiful white enamel when fused with three parts of white glass, (which contains neither lead nor other metallic oxyds,) and one of glass of borax, with a half or fourth part of nitre; yet this calx, so white when mixed with the composition of enamel, made with enamel sand and the combined oxyd of lead and tin, instead of increasing, tarnishes the whiteness, and only gives a blueish enamel of a livid colour.* Perhaps enamels, completely made and mixed together in the first instance, would not produce the same effect; but this I never tried. I have, however, employed this composition as a flux for colours, which, applied afterwards on the enamel of earthen-ware, preserved its beauty. I put some of this pure enamel also over that of earthen-ware, and I think it preserved its whiteness.

The principal quality of good enamel, and that which renders it fit for being applied on baked earthen-ware, or on metals, is the facility with which it acquires lustre by a moderate heat, (a cherry-red heat, more or less, according to the nature of the enamel,) without entering into complete fusion.† Enamels applied to earthen-ware and metals possess this quality. They do not enter into complete fusion; they assume only the state of paste, but of a paste exceedingly firm; and yet when baked one might say that they had been completely fused.

There are two methods of painting on enamel: on raw or on baked enamel. Both these methods are employed, or may be employed, for the same object. Solid colours, capable of sustaining the fire necessary for baking the enamel ground, may be applied in the form of fused enamel on that which is raw, and the artist may afterwards finish with the tender colours. The colours applied on the raw material do not require any flux; there is one, even, to which silex must be added, that is, the calx of copper, which gives a very beautiful green: but when you wish to employ it on the raw material, you must mix with it about two parts of its weight of silex, and bring the mixture into combination by means of heat. You afterwards pulverise the mass you have thus obtained, in order to employ it.

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* Antimony, employed in any manner as a glazing for earthen-ware, would be more dangerous than lead; even the latter should, if possible, be discarded.—TILLOCH.

† The ingenious author has omitted another principal quality. It ought never to contain such a portion of deliquescing salts, as to endanger its being afterwards injured by water. This takes place oftener than is generally suspected.—TILLOCH.

To obtain good white enamel, it is of great importance that the lead and tin should be very pure. If these metals contain copper or antimony, as is often the case, the enamel will not be beautiful: iron is the least hurtful.

OF COLOURED ENAMELS.

ALL the colours may be produced by the metallic oxyds. These colours are more or less fused in the fire, according as they adhere with more or less strength to their oxygen. All metals which readily lose their oxygen cannot endure a great degree of heat, and are unfit for being employed on the raw material.

Purple.

THIS colour is the oxyd of gold, which may be prepared different ways; as by precipitating, by means of a muriatic solution of tin, a nitro-muriatic solution of gold much diluted in water. The least quantity possible of the solution of tin will be sufficient to form this precipitate. The solution of tin must be added gradually until you observe the purple colour begin to appear: you then stop; and having suffered the colour to be deposited, you put it into an earthen vessel to dry slowly.* The different solutions of gold, in whatever manner precipitated, provided the gold is precipitated in the state of an oxyd, give always a purple colour, which will be more beautiful in proportion to the purity of the oxyd; but neither the copper nor silver, with which gold is generally found allayed, injure this colour in a sensible manner: it is changed, however, by iron. The gold precipitate which gives the most beautiful purple is certainly fulminating gold, which loses that property when mixed with fluxes. Purple is an abundant colour; it is capable of bearing a great deal of flux, and in a small quantity communicates its colour to a great deal of matter. It appears that saline fluxes are better suited to it than those in which there are metallic calces. Those, therefore, which have been made with silex, chalk, and borax, or white glass, borax, and a little white oxyd of antimony, with a little nitre, as I have already mentioned, ought to be employed with it. Purple will bear from four to twenty parts of flux, and even more, according to the shade required. Painters in enamel employ generally for purple a flux which they call brilliant white. This flux appears to be a semi opake enamel, which has been drawn into tubes, and afterwards blown into a ball at an enameller's lamp. These bulbs are afterwards broken in such a manner that the flux is found in small scales, which appear like the fragments of small hollow spheres. Enamel painters mix this flux with a little nitre and borax. This matter, which produces a very good effect, I employed, without attempting to decompose it. It may be a very fusible common white enamel which has been blown into that form. It is to be remarked, that purple will not bear a strong heat.

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* The colour is always more beautiful, if the precipitate is ground with the flux before it has become dry.—TILLOCH.

Red.

We have no metallic oxyd capable of giving directly a fused red; that is to say, we have no metallic calces which, entering into fusion, and combining under the form of transparent glass with fluxes or glass, give directly a red colour. To obtain this colour it must be compounded different ways, as follows:—Take two parts, or two parts and a half (you may, however, take only one part,) of sulphat of iron and of sulphat of alumine; fuse them together in their water of crystallisation, and take care to mix them well together. Continue to heat them to complete dryness; then increase the fire so as to bring the mixture to a red heat. The last operation must be performed in a reverberating furnace. Keep the mixture red until it has every where assumed a beautiful red colour, which you may ascertain by taking out a little of it from time to time, and suffering it to cool in the air. You may then see whether the matter is sufficiently red: to judge of this it must be left to cool, because while hot it appears black. The red oxyds of iron give a red colour; but this colour is exceedingly fugitive; for, as soon as the oxyd of iron enters into fusion, the portion of oxygen which gives it its red colour leaves it, and it becomes black, yellow, or greenish. To preserve, therefore, the red colour of this oxyd in the fire, it must be prevented from vitrifying, and abandoning its oxygen; which may be accomplished by the method I have indicated. I have tried a variety of different substances to give it this fixity, but none of them succeeded except alum. The doses of alum and sulphat of iron may be varied. The more alum you add, the paler will be the colour. Three parts of alum to one of sulphat of iron give a colour which approaches flesh colour. It is alum also which gives this colour the property of becoming fixed at a very strong heat. This colour may be employed on raw enamel: it has much more fixity than the purple, but not so much as the blue of cobalt. It may be washed to carry off the superfluous saline matter, but it may be employed also without edulcoration; in that state it is even more fixed and more beautiful. It does not require much flux; the flux which appeared to me to be best suited to it, is composed of alum, minium, marine salt, and enamel sand. This flux must be compounded in such a manner as to render it sufficiently fusible for its object: from two to three parts of it are mixed with the colour. In general, three parts of flux are used for one of colour: but this dose may, and ought to be varied according to the nature of the colour and the shade of it required. Red calx of iron alone, when it enters into fusion with glass, gives a colour which seems to be black; but if the colour be diluted with a sufficient quantity of glass, it at last becomes of a transparent yellow. Thus, the colour really produced by calx of iron combined with glass is a yellow colour, but which being accumulated becomes so dark that it appears black. In the process above given for making the red colour, the oxyd of iron does not fuse: and this is the essential point; for, if this colour is carried in the fire to vitrification, it becomes black, or yellowish, and disappears if the coat be thin, and the oxyd of iron present be only in a small quantity.

Yellow.

Though yellow may be obtained in a direct manner, compound yellows are preferred; because they are more certain in their effect, and more easily applied than the yellow, which may be directly obtained from silver. The compound yellows are obtained in consequence of the same principles as the red colour of iron. For this purpose we employ metallic oxyds, the vitrification of which must be prevented by mixing with them other substances, such as refractory earths, or metallic oxyds difficult to be fused.

The metallic calces which form the bases of the yellow colours are generally those of lead; as minium, the white calx of lead, or litharge, the white calx of antimony, called diaphoretic antimony: that called crocus metallorum is also employed. This regulus, pulverised and mixed with white oxyd, gives likewise a yellow. The following are the different compositions used: one part of the white oxyd of antimony, one of the white oxyd of lead (or two or three); these doses are exceedingly variable; one part of alum, and one of sal-ammoniac. When these matters have been all pulverised, and mixed well together, they are put in a vessel over a fire sufficient to sublimate and decompose the sal-ammoniac; and when the matter has assumed a yellow colour, the operation is finished.* The calces of lead mixed in a small quantity either with silex or alumine, also with the pure calx of tin, exceedingly white, give likewise yellows. One part of the oxyd of lead is added to two, three, or four of the other substances above mentioned. In these different compositions for yellow, you may use also oxyd of iron, either pure, or that kind which has been prepared with alum and vitriol of iron: you will then obtain different shades of yellow. From what has been said, you may vary these compositions of yellow as much as you please. Yellows require so little flux, that one or two parts, in general, to one of the colour are sufficient; saline fluxes are improper for them, and especially those which contain nitre. They must be used with fluxes composed of enamel sand, oxyd of lead, and borax, without marine salt.

(*To be concluded in our next number.*)

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* This in colour-shops is called Naples yellow.

THE

EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 2.] APRIL, 1813. [NO. 12.

NO. 79.

Researches respecting the Composition of Enamel. By C. CLOUET, *Associate of the French National Institute.*

(Concluded from page 400.)

A YELLOW may be obtained also directly from silver. All these mixtures may be varied, and you may try others. For this purpose you may use sulphat of silver, or any oxyd of that metal mixed with alumine or silex, or even with both, in equal quantities. The whole must be gently heated until the yellow colour appear, and the matter is to be employed with the fluxes pointed out for yellows. Yellow of silver, like purple, cannot endure a strong heat: a nitric solution of silver may be precipitated by the ammoniacal phosphat of soda, and you will obtain a yellow precipitate, which may be used to paint in that colour with fluxes, which ought then to be a little harder.

Besides the methods above mentioned, the best manner of employing the oxyd of silver is, in my opinion, to employ it pure: in that case, you do not paint, but stain. It will be sufficient, then, to lay a light coating on the place which you wish to stain yellow, and to heat the article gently to give it the colour. You must not employ too strong a heat: the degree will easily be found by practice. When the article has been sufficiently heated, you take it from the fire and separate the coating of oxyd, which will be found reduced to a regulus: you will then observe the place which it occupied tinged of a beautiful yellow colour, without thickness. It is chiefly on transparent glass that this process succeeds best. Very fine silver filings produce the same effect: but what seemed to me to succeed best in this case, was sulphat of silver, well ground up with a little water, that it may be extended very smooth. From what has been said, it may readily be seen that this yellow must not be employed like other colours; that it must not be applied till the rest have been fused; for, as it is exceedingly fusible, and ready to change, it would be injured by the other colours; and as the coating of silver which is reduced must be removed, the fluxes would fix it, and prevent the possibility of its being afterwards separated. Working on glass is not attended with this inconvenience, because the silver-yellow is applied on the opposite side to that on which the other colours are laid.

Green.

Green is obtained directly from the oxyd of copper. All the oxyds of copper are good: they require little flux, which even must not be too fusible: one part or two of flux will be sufficient for one of oxyd. This colour agrees with all the fluxes, the saline as well as the metallic; which tends to vary a little the shades. I have already pointed out the method of employing these oxyds on raw enamel: were not that method only followed in this case, the oxyd of copper would extend, and spread itself, like a cloud, beyond the limits prescribed for it.

A mixture of yellow and blue is also used to produce green. Those who paint figures or portraits employ glass composed in this manner; but those who paint glazed vessels, either earthen-ware or porcelain, employ in general copper green.

Independently of the beautiful green colour produced by oxydated copper, it produces also a very beautiful red colour; but I do not know that it is employed on enamel. This beautiful red colour, produced by copper, is exceedingly fugitive. The oxyd of copper gives red only when it contains very little oxygen, and approaches near to the state of a regulus. Notwithstanding the difficulty of employing this oxyd for a red colour, a method has been found to stain transparent glass with different shades of a very beautiful red colour by means of calx of copper. The process is as follows: You do not employ the calx of copper pure, but add to it calx of iron, which for that purpose must not be too much calcined; you add also a very small quantity of calx of copper to the mass of glass which you are desirous of tingeing. This glass at first must have only a very slight tinge of green, inclining to yellow. When the glass has that colour you make it pass to red, and even a very dark red, by mixing with it red tartar in powder, and even tallow. You must mix this matter well in the glass, and it will assume a very dark red colour. The glass swells up very much by this addition. Before it is worked it must be suffered to settle, and become compact; but as soon as it has fully assumed the colour it must be immediately worked, for the colour does not remain long, and even often disappears while working; but it may be restored by heating the glass at the flame of a lamp. It is exceedingly difficult to make this colour well; but when it succeeds it is very beautiful, and has a great deal of splendour. By employing the calx of copper alone for the processes above mentioned you will obtain, when you succeed well, a red similar to the most beautiful carmine. The calx of iron changes the red into vermilion, according to the quantity added. If we had certain processes for making this colour, we should obtain all the shades of red from pure red to orange, by using, in different proportions, the oxyd of copper and that of iron. The calx of copper fuses argil more easily than silex: the case is the same with calx of iron. If you fuse two or three parts of argil with one of the oxyd of copper, and if the heat be sufficient, you will obtain a very opake enamel, and of a vermilion red colour: the oxyd of copper passes from red to green through yellow; so that the enamel of copper, which becomes red at a strong heat, may be yellow with a weaker heat. The same effect may [illegible]duced by deoxydating copper in different degrees: [illegible] will be effected according as the heat is more or less violent. The above composition might, I think, be employed to give a vermilion red colour to porcelain. The heat of the porcelain furnace ought to be of sufficient strength to produce the proper effect.

The calx of iron fused also with argil in the same proportions as the calx of copper, gives a very beautiful black. These proportions may, however, be varied.

Blue.

Blue is obtained from the oxyd of cobalt. It is the most fixed of all colours, and becomes equally beautiful with a weak as with a strong heat. The blue produced by cobalt is more beautiful the purer it is, and the more it is oxydated. Arsenic does not hurt it. The saline fluxes which contain nitre are those best suited to it: you add a little also when you employ that flux which contains a little calcined borax or glass of borax, though you may employ it also with that flux alone.

But the flux which, according to my experiments, gives to cobalt blue the greatest splendour and beauty, is that composed of white glass, (which contains no metallic calx,) of borax, nitre, and diaphoretic antimony well washed. When this glass is made for the purpose of being employed as a flux for blue, you may add less of the white oxyd of antimony: a sixth of the whole will be sufficient.

Violet.

BLACK calx of manganese, employed with saline fluxes, gives a very beautiful violet. By varying the fluxes, the shade of the colour may also be varied: it is very fixed as long as it retains its oxygen. The oxyd of manganese may produce different colours; but for that purpose it will be necessary that we should be able to fix its oxygen in it in different proportions. How to effect this, as far as I know, has never yet been discovered.

These are all the colours obtained from metals. From this it is evident that something still remains to be discovered. We do not know what might be produced by the oxyds of platina, tungsten, molybdena, and nickel: all these oxyds are still to be tried; each of them must produce a colour, and perhaps red, which is obtained neither directly nor with facility from any of the metallic substances formerly known and hitherto employed.

GENERAL REMARKS.

THOSE who paint on enamel, on earthen-ware, porcelain, &c. must regulate the fusibility of the colours by the most tender of those employed, as for example, the purple. When the degree which is best suited to purple has been found, the other less fusible colours may be so regulated, (by additions of flux,) when it is necessary to fuse all the colours at the same time, and at the same degree of heat.

You may paint also in enamel without flux; but all the colours do not equally stand the heat which must be employed. If the enamel, however, on which you paint be very fusible, they may all penetrate it. This manner of painting gives no thickness of colour; on the contrary, the colours sink into the enamel at the places where the tints are strongest. To make them penetrate, and give them lustre, a pretty strong fire will be necessary to soften the enamel and bring it to a state of fusion. This method cannot be practised but on enamel composed with sand, which I call enamel sand, as already mentioned. It may be readily seen, also, that the colours and enamel capable of enduring the greatest heat, will be the most solid, and the least liable to be changed by the air. An account of the method of employing and baking enamel may be found in various works, and may be learned also by seeing the operations of enamellers.

No. 80.

On the Preparation of Amber Varnish, and the Application of it to different Kinds of stained Wood. By Nils Nystrom.*

AS furniture of foreign wood is in general expensive, the use of the indigenous kinds of wood ought not to be neglected, especially when they are of a compact texture, have a fine grain, and are sufficiently hard. Furniture made of these kinds of wood, after it has been well polished, may be stained of different colours, and then done over with linseed oil and amber varnish.

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* Tilloch, vol. 7, p. 232. From the *Transactions of the Academy of Sciences at Stockholm for the year* 1797.

As my principal view, however, was to try in what manner different kinds of wood could be stained so as to retain their colour longest, and in what manner mahogany could be best imitated, I applied such a composition as I thought would best answer the purpose on the twelve following kinds of wood; namely, elm, oak, red and white beech, maple, pear-tree, wild hawthorn, white beam-tree, ash, alder, birch, and pine. Of these the maple, birch, alder, and white beech, when stained with a solution of iron, had the greatest resemblance to mahogany. The appearance of the other kinds was various, according to the diversity of their colour and veins, and according as they were more or less porous, and imbibed a greater or less quantity of the stain.

The amber varnish prepared in different places is not always of equal goodness. This is owing to two causes: 1st, The careless manner in which the amber is melted; 2nd, Because the linseed oil, being too much or too little boiled, acquires, in a greater or less degree, a drying property. A proof of amber varnish being good, is, if, when applied on any article in an apartment of the common temperature, it becomes dry within from twelve to twenty-four hours.

By the experiments which I made, I have found that the following process for preparing it is the best:—Put pounded and sifted amber into a pan of cast iron with a flat bottom, and let the amber be spread out at most to the thickness of an inch. Place the pan in an upright position over an uniform coal fire, and let it remain till the amber fuses and becomes liquid; then pour it out on a cold plate of copper or iron. When the amber has cooled, break it into pieces; and if it has a bright blackish-brown appearance on the fracture, and weighs about one-half of what it did before being melted, you may be certain that it is proper for the intended purpose. Particular attention must be paid to this circumstance; for, if the amber is fused too little, so that part of it remains unmelted, it will not be dissolved by the varnish; and if the operation be performed with a continued and strong heat, it will be burnt and unfit for use.

When the amber is kept over a weak fire it will not melt, but becomes a sort of blackish brown incrustation, which also may be employed for varnish provided it has not been too much or too little evaporated: it will be in the best condition when you obtain half a pound from a pound. If the amber is too little evaporated, it must be again put into the pan till it be reduced to the proper weight. The same thing is to be observed when you melt it; but the parts which are not fused must be picked out, in order to be afterwards also melted.

I have found that a pan with a flat bottom is better than one with a round bottom, because the melting or evaporation is effected sooner in the former than in the latter; for in the latter the amber lies thick in the middle, and is burnt at the bottom and sides before it can be brought to melt or evaporate.

It is not necessary, for making varnish, to pick out pure and transparent amber, but only the common yellow small fragments, which may be procured for half the price of that in lumps. The earthy part, which is found in amber not of the clearest kind, separates itself from the warm varnish when it is suffered to stand some time before it is decanted.

Method of preparing Linseed-Oil Varnish.

ONE pound of well pulverised and sifted litharge, four ounces of finely pounded white vitriol, and one quart of linseed oil. Put these ingredients into an iron pan of such a size that it may be only half full; mix them well together, and boil them till all the moisture is evaporated, which may be known by a pellicle being formed on the surface, or by the barrel of a quill bursting when thrust to the bottom of the boiling varnish. Then take it from the fire and pour off the clear liquid, taking care to keep back the thick part which has deposited itself at the bottom. While boiling, it must be stirred several times round, that the litharge may not fall to the bottom; but you must not stir it constantly, else superfluous litharge would be dissolved, and the varnish become too thick.

The composition of amber varnish consists of half a pound of melted or roasted amber, one pound and a half of linseed-oil varnish, and two pounds of turpentine oil. The amber and linseed-oil varnish are to be mixed together in a deep cast-iron pan, of such a size as to be only one-third full, and to be kept over a slow fire till the amber is dissolved, which may be known by its swelling up: the operator, therefore, must have at hand a large copper or iron vessel, that the varnish may be held over it in case it should rise above the sides of the pan, and to prevent the loss that would thereby be occasioned. When the varnish is dissolved, the pan must be taken from the fire; and when the mixture has cooled, the turpentine oil is to be poured into it, continually stirring it. Then let it stand some time, that the course undissolved particles may deposit themselves at the bottom; after which pour off the clear varnish, and, having strained it through a piece of linen, put it into bottles for use.

In boiling the varnish, care must be taken that it may not boil over or catch fire. Should this happen to be the case, it must not be extinguished by water; for this mode would occasion such a sputtering, that the operator would be in danger of having his face bespattered with the boiling varnish. The best method, therefore, is to cover the vessel in such a manner as to exclude the air, and with any thing that may be at hand, such as a piece of wood, plate of iron, or any thing else that may cover the vessel and extinguish the flame.

1. *Iron Stain.*

Eight ounces of iron-filings and thirty-two ounces of common aquafortis. The aquafortis must first be mixed with sixteen ounces of water in a stone jar, and then a few of the filings are to be added, and well stirred round with an iron or wooden spatula. This preparation must be made in a chimney, because the solution is attended with heat, effervescence, and the disengagement of noxious vapours: it is of importance, also, that the jar should be of such a size as to prevent the matter from running over. After the greater part of the iron has been dissolved in this manner, the solution will be of a yellowish brown colour. As soon as the mixture has cooled, pour it into a bottle placed in a pan, and let it stand a day or two, without being corked, over a warm stove; during which time shake the bottle frequently. The bottle being then suffered to cool, pour into it one pound three quarters of river water, stirring it well round, and leave it at rest for a few minutes till the undissolved part sinks to the bottom: then pour the solution into another bottle, and cork it up for use.

When this preparation has been carefully made according to the above directions, you obtain a yellowish brown solution, which may be employed for staining. In case too much water, however, has been at first employed, or too weak aquafortis, the colour becomes dark brown; and therefore the addition of the aquafortis must be increased in that proportion which the solution requires, observing the above rules.

This stain may be applied to all kinds of wood except oak, which contains too much astringent matter, and therefore on the first application becomes almost black. It communicates to the various kinds of wood different colours, according as it is applied in greater or less quantity; such as yellow, yellowish brown, and dark brown, with reddish brown stripes or spots.

As far as I have been able to ascertain by experience, this stain is one of the most durable; it withstands the air and rays of the sun without changing its colour. I have specimens of it which have been exposed four years continually to the sun and air, without their colour being altered.

2. *Brazil Wood Stain.*

Eight ounces of real Brazil wood, four ounces of alum, and four ounces of finely pounded reddle or red ochre. Pour over this mixture a proper quantity of water; and, having suffered it to remain in that state twenty-four hours, boil it to a fourth part; then strain it through a piece of linen cloth, and preserve it in a glass bottle for use.

If one pound of the stain No. 1, be diluted with three pounds of water, immerse some pieces of wood in it, and deposit the whole in a warm place: the wood will imbibe the liquid to the depth of a quarter of an inch, and in the soft parts of the wood it will penetrate still further.

It must however be remarked, that the staining liquor must be diluted with a greater or less quantity of water, according as the wood is darker or whiter, more or less astringent. The wood must often be turned, and care must be taken that it may acquire an uniform and proper colour; after which it may be taken out and dried.

The like process must be followed when the stain, No. 2, is employed, only that the same attention is not necessary in regard to obtaining an uniformity of colour. This mode, however, can be used only on a small scale.

Method of staining Articles of White Wood with the above Compounds.

Rub the stain No. 1, over the wood with a piece of sponge five or six times till it acquire a proper mahogany colour. While the liquor is applied, shake it or stir it carefully round, that the iron ochre, which has deposited itself at the bottom, may be well mixed with the ferruginous solution that stands over it; and between each application of the liquid the wood must be suffered to become thoroughly dry. After this, it must be rubbed over once or twice with linseed oil, letting it dry before the oil is applied the second time. The more the wood is soaked with linseed oil, so much the better; as in that case it does not imbibe so much of the amber varnish, which only deposits itself on the surface, and gives it a bright appearance.

When the wood has been thus rubbed over, and well dried, the amber varnish must be applied in an uniform manner with a sponge once or twice, or until it acquires a smooth shining surface. If the wood has been well done over with linseed oil, one application of the varnish only will be necessary; but on bedsteads, chests of drawers, chairs and other furniture which are exposed to more use, it must be applied several times, and each time they must be well dried.

After the application of the varnish, if any inequalities or lumps appear, they may be removed, after the article is dry, by means of a carpenter's rush, and a fresh coating of varnish applied to the place. For applying the varnish, I have found it most convenient to use a sponge; as by these means it can be laid on in a much more uniform manner than by a painter's brush, which, for the most part, leaves stripes or loose hairs behind it. The sponge with which the varnish is laid on, must, between each application, be well shut up in a wide-mouthed bottle, that the varnish it has imbibed may not be dried by the air, which would render it hard, and unfit for use.

The same process is to be followed with the stain No. 2. When applied to knotty birch wood or alder, the wood becomes undulated, because the liquor extends itself crosswise. The case is the same with fat and knotty pine wood or fir; for the resinous spots do not so strongly attract the stain as the other parts. This, however, makes the appearance of the wood not disagreeable.

The amber varnish may be applied also over almost all oil colours except blue, which it would change to green. It is attended with this advantage, that it never cracks; as is the case in general with lack varnishes, and those prepared with spirit of wine.

I have found, also, that this varnish is proper for being applied on real gilding, because it makes no perceptible alteration in the colour; especially when laid on thin, and in an uniform manner. This object also is obtained, that the gilding may be cleaned by means of spirit of wine, or of soap and water, without sustaining any injury. For false gilding, however, it is improper; as it attacks it, and makes it rusty and green.

I have applied this varnish, in the above manner, to bed-posts, drawers, tables, and chairs, which at the end of two years were little or nothing changed in their appearance. When this varnish has become perfectly dry and hard, it withstands boiling heat and friction; and does not lose its splendour by the course of time, unless rubbed or scoured with sand. It prevents ink, or any other coloured liquid that may be spilt on furniture, from penetrating into the wood, and causes stains to be easily removed by washing with water. On this account, it is very proper for being applied on articles of mahogany. It renders the soft kinds of wood much harder at the surface.

This varnish used in this manner would not be expensive, as eight ounces of it is sufficient for a common card-table. Should the table be scratched, the injured part may be easily repaired by a new coating of varnish; and if it be new varnished every four or five years, it will always retain a beautiful and bright appearance.

Tables and other flat articles which require a great deal of polishing, when the stain and linseed oil have been applied, may be rubbed with a piece of pumice stone before they are done over with the varnish. This pumice stone must be made flat on one side, and must be free from sand, so as not to scratch the wood. As the softer kinds of wood swell up, for the most part, when the stain is applied, and lose their smoothness, rubbing them in the above manner with pumice stone is the more necessary.

NO. 81.

Method of giving the Grain and Hardness of Steel to Copper. By B. G. SAGE.*

MARGRAFF and Pelletier have published their researches on the union of phosphorus with different metallic substances: the French chemist has improved this process, and it was by repeating and varying his experiments that I discovered that the surest and speediest means of phosphorizing copper was to take the metal under the metallic form, to fuse it with two parts of animal glass, and a twelfth of charcoal powder; but it is essential that the copper should present a great deal of surface,—an advantage obtained by taking shavings of that metal, which are placed in strata with animal glass mixed with charcoal powder. I expose the crucible to a fire sufficiently strong to fuse the animal glass. There is then formed phosphorus, the greater part of which burns, while another combines with the copper, in which it remains incarcerated till no more is disengaged, though kept in fusion for twenty minutes under the animal glass which has not been decomposed.

When the crucible has cooled, and is broken, the phosphorated copper is found in the form of a gray brilliant button under the glass, which has passed to the state of red enamel. On being weighed, it is found that by this operation its weight has been increased a twelfth.

If the phosphorized copper, when fused, falls on a plate of polished iron, it extends itself over it in the form of plates differently figured, which exhibit the play of colours of a pigeon's neck.

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* Tilloch, vol. 20, p. 159. From the *Journal de Physique,* Messidor, an. 12.

The phosphorized copper is much more fusible than common copper: it may often be fused under charcoal powder without losing any of its properties.

The same phosphorized copper, when exposed a long time under the muffle, separates only with great difficulty from the phosphorus.

The copper thus combined with phosphorus acquires the hardness of steel, of which it has the grain and the colour: like it, it is susceptible of the finest polish; it can be easily turned; it does not become altered in the air. I have kept buttons of polished phosphorized copper in my laboratory for fifteen years, without their experiencing any alteration. The copper emits no smell when rubbed. Were it ductile, it would be of the greatest utility, since no fat bodies seem to have any hold of it.

In the phosphorization of copper there is only a part of the animal glass decomposed, because a quantity of charcoal necessary to phosphorize the whole acid has not been employed: but it is necessary that this should be the case in order that the vitreous scoria should be sufficiently fluid for the phosphorus to be disengaged and to collect itself readily.

The dark red enamel which is formed in this experiment may be employed with advantage for porcelain and enamels, as this red does not alter in the fire.

Copper can combine with phosphorus only in the dry way. If a cylinder of phosphorus be put into a solution of nitrate of copper diluted with four or five thousand parts of water, copper under the metallic form will be found at the end of eight days crystallized and ductile, forming a case to the cylinder of phosphorus.

No. 82.

The Art of moulding Carving in Wood. By LENORMAND, *Professor of Natural Philosophy in the Central School of the Department of Tarn.*[*]

INGENIOUS or curious men are often thwarted in the execution of their projects by the difficulty of finding in the places where they reside workmen capable of assisting them in the articles for which they may have occasion. Small towns in particular furnish only indifferent workmen; and besides, they do not contain artists of every kind. Good carvers, for example, reside only in large towns; and these even are not very common. I had seen plaisterers supply the want of good modellers by incrusting in their decorations plaister moulded on excellent models. I therefore conceived that it might be possible to mould carving in wood, to be afterwards applied to cabinet-makers' work. This idea I did not at first carry into execution; but two or three years after, having occasion for some pieces of carving, I invented a new art,[†] as will be seen by what follows. Necessity rendered me industrious, and I at length accomplished my object.

Wishing to obtain a case for a pendulum clock I had constructed, I drew a plan of it; and presented it to an excellent cabinet-maker in the small town in which I resided. He would undertake only the plain work, and referred me for the execution of the carving to Toulouse or Bourdeaux. I was sensible how difficult it would be to get the carving of the different pieces executed at a distance, and particularly within the required time; and how expensive it would be to transport such a case, which might also be damaged by the way. I told him that I would myself undertake the carving of the laurel and oak foliage which I had placed in the plan, provided he would undertake the remaining part. Fearing, however, that my carving would not correspond to his work, and might tend to degrade it, he was unwilling to undertake any thing till I had shown him a specimen of my labour—a proposal to which I consented.

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[*] Tilloch, vol. 16, p. 247. From the *Bibliothèque Physico-Economique,* June 1803.

[†] This art is not new; but the experiments of the author may furnish useful hints to artists.—TILLOCH.

I was well aware that very hard wood, such as box, might be moulded by putting it under a press in copper moulds, after having subjected it to certain preparations: but for this purpose very expensive moulds, an excellent press, &c. are required, which occasions considerable expense, and by this method bas-reliefs only can be executed. But the art I am about to describe requires only cheap materials with very little practice, and affords the means of making not only figures in relief, but even the most difficult objects of sculpture.

In the town where I resided I found one of those Italians who employ themselves in moulding plaister figures. I caused him to make such moulds as I had occasion for, and which were copies from the best masters. I succeeded perfectly in moulding my garlands in walnut-tree wood; and I showed them to my cabinet-maker, who took me for an able sculptor. He constructed the case, applied to it the foliage I had made, and neither he nor any person who saw it had the least suspicion of the method I had employed. All believed that the ornaments had proceeded from the chisel of an able carver. Since that time I have moulded for my friends bas-reliefs, trophies, &c. with wood of every kind. I shall now describe my process.

Process.

I MADE very clear glue with five parts of Flanders glue and one part of fish glue or isinglass. I dissolved these two kinds of glue separately in a large quantity of water, and mixed them together after they had been strained through a piece of fine linen to separate the filth and heterogeneous parts which could not be dissolved. The quantity of water cannot be fixed, because all kinds of glue are not homogeneous, so that some require more and some less. The proper degree of liquidity may be known by suffering the mixed glue to become perfectly cold: it must then form a jelly, or rather a commencement of jelly. If it happens that it is still liquid when cold, a little of the water must be evaporated by exposing the vessel in which it is contained to heat. On the other hand, if it has too much consistence, a little warm water must be added. In a word, the proper degree will be ascertained by a few trials.

The glue thus prepared is to be heated till you can scarcely endure your finger in it: by this operation a little water is evaporated, and the glue acquires more consistence. Then take fine raspings of wood or sawdust, sifted through a fine hair-sieve, and form it into a paste, which must be put into moulds of plaister or sulphur after they have been well rubbed over with linseed or nut-oil, in the same manner as when plaister is to be moulded. Care must be taken to press the paste in the mould with your hand, in order that it may acquire all the forms of the mould: then cover it with an oiled board, and, placing over it a weight, suffer it in that manner to dry. The desiccation may be hastened and rendered more complete by a stove. When the impression is dry remove the rough parts, and if any inequalities impression hind they must be smoothed; after which the remain be-may be affixed with glue to the article for which it is intended. Then cover it with a few strata of spirit of wine varnish, as is done in general in regard to carved work, or with wax in the encaustic manner. It requires much attention to discover that such ornaments are not carved in the usual manner. Gilding may be applied to them with great facility. This operation is exceedingly easy; nothing is necessary but moulds; and with a little art the ornaments may be infinitely varied.

I tried also to mould figures, and completely succeeded. These, however, require more care. I first make a paste, similar to the former, with very fine sawdust, and place a stratum, of about two lines in thickness, on every part of the mould; after which it is left to dry almost entirely. In the mean time I prepare a coarse paste with coarse sawdust which has not been made to pass through a fine but a coarse sieve, and instead of Flanders glue I employ common glue, which is less expensive, adding to it a sixth of fish glue. I first put together two parts of the mould, after introducing into the joints a slight stratum of the fine paste, which I make very clear and apply with a small brush. I fill up the vacuity between the two pieces with coarse paste. I then apply the third piece as I did the second, and so on until the whole are adjusted, always filling up the vacuities with coarse paste. I suffer the whole to dry in the mould, and obtain a figure in relief of solid wood executed with all the delicacy of plaster figures, Care must be taken to remove with a sharp knife, or a small file, the prominences formed by the joinings. If the figure be not suffered to dry too much, these prominences may be easily removed with the point of a sharp penknife. It will be necessary to learn the art of determining the proper degree of desiccation; for if the figure be taken from the mould before it is properly dried it will become warped, and if it be too dry it cannot be corrected but with a file, which is tedious and laborious, whereas if the proper moment be seized the paste may be cut like wax; especially if the sawdust has been fine which is necessary for the exterior strata. The figures may then be completely dried in a stove, by which means they will acquire a degree of desiccation and solidity hardly to be conceived. Figures thus moulded may be bronzed or varnished: they will then be unalterable by the effects of moisture or dryness.

I have already said that Flanders and not common glue ought to be employed for the exterior strata, because this glue is almost colourless;* whereas the other, being dark-coloured, gives too obscure a tint even to walnut-tree wood. Being desirous to try whether my moulded figures would be unalterable by the effects of moisture or dryness, I made the following experiments:

Experiment I.

I EXPOSED in a large bell-glass filled with atmospheric air two figures, one of which was varnished and the other not. I placed under the bell Saussure's hygrometer and a capsule filled with water, after having moistened the sides of the bell. The air was soon saturated with water, and the hygrometer marked 100 degrees. I observed no alteration whatever in the varnished figure, and the other exhibited no other sensible alteration than a commencement of solution in the glue, so that on applying my finger to its surface it was found to be somewhat viscid; in a word, the figure was not in the least warped.

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* When this cannot be had, a glue fit for the purpose may be made by boiling shreds of parchment in common water till dissolved.—TILLOCH.

Experiment II.

I THEN introduced my two figures and the hygrometer into another very dry bell, under which I had placed a capsule filled with calcined potash. The moisture of the air by which the figures were surrounded was soon absorbed, and the hygrometer indicated zero. In order to ascertain whether the whole moisture imbibed by the unvarnished figure was entirely dissipated, I left every thing *in statu quo* for four hours, the hygrometer still indicating zero. I then took out the two figures, neither of which had experienced the least alteration.

Experiment III.

I REPEATED the first experiment with a view to cause the two figures to absorb as much moisture as possible; and when the hygrometer marked 100 degrees I took them from the bell, and suddenly introduced them into a stove the heat of which was 50 degrees of Reaumur. The unvarnished one became dry without cracking, and the other showed a little softening in the varnish. This effect I ascribed to the imperfect desiccation before the experiment, for the softening was more considerable than is generally the case when a varnished body is exposed to heat.

These experiments appeared to me sufficient to induce me to conclude, that sculpture in moulded wood, according to the process here described, is unalterable by moisture or drought, for in our climates the thermometer never rises to 50 degrees. Such sculptured figures have the solidity of wood, and are even preferable to it; for a slight blow given to wood, if cut across the fibres, will detach some of the parts; whereas figures formed of artificial wood, if I may be allowed the expression, are homogeneous in all their parts, and are not so easily broken.

Besides the advantages which this invention on the first view exhibits, it offers others which may be of great utility in our arts and manufactures.

1st, In the large manufactories of mirrors the ornaments in general are in a very bad taste and miserably executed, because the carvers are very ill paid. If this new method be adopted, sculptors would pay more attention to their first work: they would mould their ornaments in plaster or in sulphur, then take a multitude of copies with the greatest facility, and these ornaments would add to the value of our furniture.

2d, Inlayers would make much more elegant works by employing pastes of different coloured woods, which might be managed with greater ease than the thin pieces of coloured boards which they employ. I am now engaged with some experiments on this subject. My intention is to make small tablets to imitate mosaic. I shall communicate the result to the public as soon as my experiments are terminated.

No. 83.

A Memoir concerning several indigenous Plants, which may serve as a Substitute for Oak Bark, and for certain foreign Articles in the Tanning of Leather.[*]

THE object of this memoir is to show how the destruction of trees, and particularly of oak-trees, which are so valuable, may in great part be prevented. A great consumption of them is caused by the tanneries.

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[*] Tilloch, vol. 17, p. 140. From the *Transactions of the Royal Society of Berlin*, vol. 10.

A discovery has been made last summer, which will contribute to the preservation of the trees, and to the continuation and even to the increase of the tanneries. Eight new sorts of leather have been prepared and tanned without any bark at all, and with materials of which we shall give a detailed account. By using these articles, there is a saving, not only of bark, but likewise of several foreign drugs, which are generally used in tanning. It is surprising that the experiments on which this discovery is founded have not been made sooner, as they are exceedingly easy, and the various methods practised by other nations, and even by the most savage ones, for making leather, pointed out the way to them. In fact, be it owing to the want of bark, or to old practice, it is usual in several countries to tan leather with leaves, roots, fruits, and juices. We shall not enter now into all the historical details of which the subject is susceptible; but it is proper, however, to give a sketch of them.

Some of the Calmuc Tartars, that rove about towards the great wall of China, tan the skins of their horses with sour mares' milk. In Persia, Egypt, and some countries bordering on Africa, goats' skins are tanned with the astringent and leguminous fruit of the true acacia, which is gathered before it is ripe. In several parts of the Turkish empire the same skins are made into Morocco leather by the means of galls. The green nuts of the turpentine tree, and, according to some, even the leaves, as likewise those of the lentisk tree, serve for the same purpose in many parts of the Levant. The *smak*, or bundles of the leaves and young branches of sumach, is very well known, and is used in all countries for the making of Cordovan leather. It is also well known that in several provinces of Italy, Spain, and France there are actually used several plants, which may be called *plantæ coriariæ*, such as the *arbutus*, the *celtis*, the *tamarisk*, the *rhamnus*, the *rhus myrtifolia*, &c. In Sweden they use the bark of one of the small species of mountain sallow, as also a wild plant known by the name of *uva ursi*. The Silesians use in tanning a sort of myrtle called *rausch*. But for tanning, nothing is used in Germany but the bark of oak and birch tree, with some acorn shells; and as to the making of Cordovan and Morocco leather, they use sumach and galls, as almost all other nations do.

When the eight new methods of preparing leather already alluded to shall be once introduced, all the other articles will be no longer necessary; and there will be found in his majesty's dominions the plants fit for tanning, among which are some that will serve also for dyeing skins. We have already about sixty species of such plants; and if, after having made an exact choice, there should remain but twenty of them, our object will be attained, both as to the preservation of wood, and the doing without foreign articles.

Skins differ from each other according to the species of animals, as likewise according to their age, food, and the climate they belong to; whence it follows, that there must be various methods of tanning, all which can be reduced to the three methods called in Germany *weiss-gahr* (white preparation), *semisch-gar*, (soft preparation,) and *loh-gahre* (tanning). I omit parchment, shagreen, and what concerns skinneries.

The first preparation is the same in these three methods. When the skins are well cleansed, lime, or sand and salt are made use of to take off the hair, and then they are washed several times, &c.

But the following part of the process is not the same in these different methods. We shall omit at present the two first methods, which require several ingredients taken from the three kingdoms of nature, such as alum, common salt, raw tartar, bran, meal, and fish oil; but it is necessary to enter into some details with regard to the third, in which vegetables alone are used, that serve to make a sort of ley, by means of which the tanning is completed.

This third method can be subdivided again into four sorts, according to the four principal sorts of leather that are prepared with the help of different vegetables, viz. 1. Common leather; 2. Cow's leather; 3. Cordovan; 4. Morocco leather.

Every vegetable ley fit for making leather is either cold or hot.

The cold process is the simplest and easiest, but, at the same time, the slowest; it is used for the coarsest and heaviest sort of skins, which are put in holes, or in wooden vessels, with oak or birch bark.

The method of tanning with hot leys is often very troublesome, but it is more expeditious than the former one. Some sorts of leather require three weeks; others eight, twelve, or fifteen days. From twenty-four to thirty-six hours are sufficient for Cordovan; Morocco leather takes seven or eight hours, and sometimes from sixteen to twenty. This method is as follows: The ley is poured into wooden vessels, together with hot water; the skins are put into it, and stirred often. After eight days time the water is thrown out, heated again, poured upon fresh ley, and the whole is poured upon the skins. This operation is continued and repeated until the vegetable parts have penetrated the substance of the skins so as to change them into leather; which is then dried, and given over to the curriers.

We may remark here, that cow leather cannot be made as cheap with us as in Russia; and that the scented sort called *cuir de Roussi* derives that property from two empyreumatic oils, which it is rubbed with in the preparing of it.

As to Cordovan and Morocco leather, they are made of goats' skins, and prepared, the one with sumach, the other with galls.

We have said enough concerning the general principles of tanning. so as to throw a light upon what relates to the plants that can be made use of in it.

There is abundance of these plants in our country, and eight new methods of preparing leather with them have been discovered. They have been treated of in a memoir that was read before the academy on the 5th of last December. The author of this memoir, and the maker of these new sorts of leather, is M. Klein, a native of Nauen. He requested I should show him all the plants that I thought fit for tanning. I have mentioned the names of these plants to the academy, and specified their properties. They are all indigenous plants, very common and abundant, and which have been heretofore considered as noxious weeds, as the utility of them was not known; and accordingly, their being used in tanning will not be in the least hurtful to private economy. M. Klein has collected a considerable quantity of these species of plants; and among the eight sorts of leather that have been made with them there is very fine Cordovan prepared without sumach, and two sorts of calf-skin, tanned only with leaves of trees.

These coriaceous plants grow in almost all deep places and marshy grounds; there are some of them found also in sandy soil, on hills, and in woods. The hay which they yield is the coarsest of all, and in very small quantity; the cattle never touch it, except when they are starving with hunger. Such plants spoil good meadows. A great quantity of them is to be had, particularly near lakes and large ponds; and it is no exaggeration to say that there are sixty species of them.

It is very easy to discover the chemical principles in virtue of which these plants are fit for tanning, if one has a knowledge of those of sumach, galls, and different sorts of bark. With regard to this point, the plants may be divided into two principal classes. The principles that are chiefly to be considered are found generally in all of them; they are of a *fixed*, but still *active*, *terreo-gummy*, or *terreo-resinoso-gummy* nature. Besides these common principles, some other very active ones exist in some of these plants, in a greater or less quantity; and this is what constitutes the difference that we establish between the plants that can be used in tanning.

Those of the first sort have no smell, or at most a very weak one, but they have a very sharp and astringent taste. They contain only the active and fixed principles which we have mentioned, or at most an inconsiderable mixture of oleo-inflammable parts, which give a weak balsamic smell to the water distilled from them, without any sharp or styptic taste. The proportion of these parts varies in the terreo-resinoso-gummy substance; but that which commonly exists in the greatest part of the coriaceous plants is such, that, for instance, in a pound of them the terreous parts constitute one-third, or even one-half; and the gummy principle about one-fourth or one-third, and in some as much as one-half, while the proportion of rosin is the smallest of all, being only from twenty to fifty grains, or at most a drachm and about twenty grains.

In the second sort of these plants we find, indeed, the above-mentioned fixed active principles, but not in the same proportion, because they are mixed with other principles both volatile and fixed, so as to constitute the smaller part of the whole compound. Besides the fixed parts there exists in these substances an unctuous balsamic *oleoso-*, or *vaporoso-spirituoso-ethereous* principle. The volatile parts become soon disengaged from the rest, by the heat of the tanning ley, and evaporate, so that it is not at all times possible to discover any specific remains of them in the leather.

If we examine next what the fixed *terreo-gummy* or *terreo-resinoso-gummy* substance consists of, we shall obtain a very clear knowledge of it, either from considering the manner in which it is naturally produced, or by means of chemical experiments. This terreous matter is sometimes coarser, sometimes finer, sometimes in a greater and sometimes in a smaller quantity; and it contains an oily substance, or inflammable principle, attached to a light acid, of the nature of vegetable acid, but not caustic, like mineral acid. In analysing the fixed substance of coriaceous plants, we get by the alembic, out of a pound medical weight, nearly the following parts, in a proportion more or less different: 1. About an ounce and two drachms of a clear, empyreumatic, but not astringent phlegm; 2. About two ounces and five drachms of an acid yellowish liquor; 3. An ounce and somewhat more than six drachms of an empyreumatic oil. The *caput mortuum* often constitutes one half, or even more, and sometimes contains a portion of fixed alkaline salt. In dry fruits, juices, and bulbous roots, this proportion suffers some exceptions. It is easy to conceive that the knowledge of these component parts, of their respective quantities, and of their properties, which are well known to chemists, may lead to that of their effects, and of the manner in which they produce them. We shall be able then to distinguish a false tanning plant from a real one, or to lay aside such as are too weak for that purpose. There are some, for example, that are much fitter for giving a fine dye to leather than for tanning it.

Nor is it difficult, after what we have said concerning the principles contained in the plants, to form an idea of their action upon skins, properly cleansed and macerated. The skins being left steeping in a decoction of these plants, or merely along with the coarse dust of them, undergo a change in the tissue of their parts, whereby they become leather. In this operation the soluble and active parts of the vegetables are separated from the coarse mass, with the help of air, evaporating moisture, water, work, and various degrees of heat. They remove imperceptibly from each other, and extend in every direction in a very gentle manner, which renders them fit for softly penetrating the substance of the skins, and producing gradually an alteration in them. It is easy to comprehend the effects which, in such a case, a gentle acid is capable of producing, when dissolved, mixed, and put in action with other particles highly volatile, oleoso-ethereous, and of great mobility. The skins are penetrated with these particles, and with those which we have called terreo-resino-gummy, as if with a sort of balsam, and are thereby condensed into leather. But as it is not our intention to enlarge upon the theory of tanning, we shall confine ourselves to our object, which is the indication of tanning plants, and shall mention another property of them, whereby they are plainly distinguishable from all others. This property occurs in their dust, or in a decoction of them, when mixed with copperas (vitriol de mars).

Take then these plants, and reduce them into dust, which you will throw into a solution of copperas; or put some copperas into an infusion or decoction of the plants which has been previously filtrated. The colour produced by this mixture is sometimes reddish or of a dark red, and sometimes blue or black. The cause of this phenomenon is known to chemists, who know also how to make these decoctions or infusions transparent, and to make the colours disappear, by pouring into them, drop by drop, a sufficient quantity of oil of vitriol.

The properties of these plants being thus sufficiently ascertained, and there being the greatest plenty of them in the country, it remains now for the connoisseurs to extend the use of them, and to apply them further to the advantage of our national manufactures.

A List of the Plants that have been used in the Experiments on Tanning.

The number of plants fit for tanning is much greater than that of those in the following list; and it has been observed that, if they be gathered at proper seasons, they can be used for the preparing of all sorts of skins, both coarse and fine. The best of them are such as have the greatest quantity of a coarse, astringent, and acid substance. They are also the fitter for penetrating the skins, in proportion as they contain a greater portion of aromatic and spirituous parts, and are possessed of an essential ethereous oil. On the contrary, the inferior species of them are those whose substance is principally composed of fat or mucilaginous parts, which do not make so strong an impression on the skins, and can scarce serve for tanning the most tender ones.

Salicaria *vulgaris purpurea, foliis oblongis.* Tourn. Instit. 253. Lysimachia spicata purpurea, fortè Plinio. C. B. pin. 246. Purple-flowered loosestrife.

Ulmaria; Clus. Hist. 198. I. B. III. 488. Regina prati. Dodon. Pempt. 57. Queen of the meadows.

Comarum; Linn. Gen. pl. ed. 5. 563. Quinquefolium *palustre rubrum.* C. B. pin. 326. Red marsh cinquefoil.

Filix *ramosa major, pinnulis obtusis, non dentatis*. C. B. pin. 357. Filix fœmina offic. et Dodon. Pempt. 462. Common brackens, or female fern.

Filix *non ramosa, dentata*. C. B. pin. 358. Filix mas offic. et Dodon. Pempt. 462. Common male fern.

Filix *palustris maxima*. C. B. Prodr. 150. Water-fern.

Filix *mas aculeata, major et minor*. C. B. Prodr. 151.

Persicaria *salicis folio, potamogeton angustifolium dicta*. Raj. Hist. 184. Arsmart.

Persicaria *acida Jungermanni*. Water knot-grass.

Bistorta *major, radice minus vel magis intorta*. C. B. pin. 192. Snake-weed.

Tormentilla *sylvestris*. C. B. pin. 326. Wild tormentil.

Pimpinella *sanguisorba major*. C. B. pin. 160. Large wild pimpernel.

Caryophyllata *vulgaris*. C. B. pin. 321. Common avens, or herb bennet.

Caryophillata *aquatica, nutante flore*. C. B. pin. 321. Water avens.

Anserina *offic. argentea*. Dod. Pempt. 600. et *Potentilla*. I. B. II. 398. Goose-grass.

Quinquefolium *majus repens*. C. B. pin. 325. Large cinquefoil.

Quinquefolium *minus repens luteum*. C. B. pin. 325. Spring cinquefoil.

Quinquefolium *folio argenteo*. C. B. pin. 325. Satin cinquefoil.

Horminum *pratense, foliis serratis*. C. B. pin. 238. Clary.

Agrimonia *offic*. Agrimony.

Equisetum *arvense, longioribus setis*. C. B. pin. 16. Horse-tail.

Equisetum *palustre, longioribus setis.* C. B. pin. 15. Marsh horse-tail.

Alchemilla *vulgaris.* C. B. pin. 319. Common lady's mantle.

Muscus *pulmonarius,* sive Pulmonaria offic. Lob. Ic. p. 248. Pulmonaria arborea, Muscus quernus. Oak moss.

Lysimachia *lutea major, quæ Dioscoridis.* C. B. pin. 245. Yellow wood-loosestrife.

Vaccinium; Rivini. *Vitis idæa, foliis oblongis crenatis, fructu nigricante.* C. B. pin. 470. Black-worts—in Irish *Fraochan.*

Vaccinium *foliis buxi, sempervirens, baccis rubris.* Rup. flor. Gen. p. 52. Red bilberry.

Rubus *vulgaris,* s. *fructu nigro.* C. B. pin. 479. Common Bramble.

Rubus *repens, fructu cæsio.* C. B. pin. 479. Dewberry.

Fragaria *vulgaris.* C. B. pin. 326. Strawberry.

Filipendula; I. B. II. 189. Saxifraga *rubra off.* Red Saxifrage.

Pervinca; Tournefort. Vinca pervinca offic. Clematis daphnoides *major, flore cerulæo.* I. B. II. 132. Periwinckle.

Sparganium *ramosum et non ramosum.* C. B. pin. 115. Burn-reed.

Filago; seu *herba impia.* Dodon. Pempt. 66. Common cudweed.

Gnaphalium *montanum flore rotundiore et longiore.* Tourn. Inst. 453. Mountain cudweed.

Geranium *sanguineum maximo flore.* C. B. pin. 319. Bloody crane's bill.

Geranium *batrachoides maximum, minus laciniatum, folio aconiti.* I. B. III. 477. Meadow crane's bill.

Plantago *latifolia incana.* C. B. pin. 189. Broad-leaved plantain.

——— *angustifolia major et minor.* C. B. pin. 189. Narrow leaved plantain, both great and small.

——— *latifolia sinuata.* C. B. pin. 189. All sorts of plantain.

Hypericum *offic. et Matthiol. vulgare.* C. B. pin. 279. Common St. John's wort.

It is proper to observe in this place, that only the herbs in flower, or even the flowers alone, of the preceding plants are to be used. Some of them are more weak than others, and accordingly must be used in a different way. But as to the following ones, their leaves and branches, as likewise the unripe fruits of them, the seeds, and even the roots of some of them, are all equally fit for tanning.

Frondes *vitis viniferæ.* The vine.

Prunus *sylvestris.* Wild plum-tree; its bark and unripe fruit.

Salix *vulgaris alba arborescens.* Common white willow; its leaves and twigs.

—— *caprea rotundifolia.* Common willow; its leaves, bark, twigs.

Rosa; sylvestris, variorum colorum. Wild rose-bush: its leaves.

Fagus. Beech. Bark and leaves.

Carpinus. Horse-beech. Bark and leaves.

Quercus. All sorts of oak. Leaves.

Betula. Birch-tree. Bark and leaves.

Alnus. Alder. Leaves.

Mespilus; *species sylvestris vulgaris.* Wild medlar. Leaves, twigs, unripe fruit.

Ledum *rosmarini folio.* Wild rosemary.

Cornus *sylvestris mas.* Wild cornel tree. Leaves, twigs, stones.

Acetosa *pratensis.* Sorrel. Root. Seed.

Lapathum *maximum aquaticum.* Large water-dock. Root, leaves, seed.

Lapathum *folio acuto plano.* C. B. pin. 115. Sharp-pointed dock. Root, leaves, seed.

Iris *palustris lutea.* Acorus adulterinus. C. B. pin. 34. Water-flag. Root.

Nymphæa *lutea major.* C. B. pin. 193. Yellow water-lily. Root.

——— *alba major.* C. B. pin. 193. White water-lily. Root.

NO. 84.

Process for Dyeing Nankeen Colour. By Mr. RICHARD BREWER.*

MIX as much sheep's dung in clear water as will make it appear of the colour of grass, and dissolve in clear water one pound of best white soap for every ten pounds of cotton-yarn, or in that proportion for a greater or lesser quantity.

Observe:—The tubs, boards, and poles, that are used in the following operations must be made of deal; the boiling-pan of either iron or copper.

First Operation.

POUR the soap liquor prepared as above into the boiling-pan; strain the dung liquor through a sieve; add as much thereof to the soap liquor in the pan as will be sufficient to boil the yarn, intended to be dyed, for five hours. When the liquors are well mixed in the pan, enter the yarn, light the fire under the pan, and bring the liquor to boil in about two hours, observing to increase the heat regularly during that period. Continue it boiling for three hours, then take the yarn out of the pan, wash it, wring it, and hang it in a shed on poles to dry. When dry, take it into a stove or other room where there is a fire; let it hang there until it be thoroughly dry.

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* Tilloch, vol. 17, p. 149. From the *Transactions of the Dublin Society*, vol. 1, part 1.

N. B. The cotton yarn, when in the shed, should not be exposed either to the rain or sun: if it is, it will be unequally coloured when dyed.

Second Operation.

In this operation use only one half of the soap that was used in the last, and as much dung liquor (strained as before directed) as will be sufficient to cover the cotton yarn, when in the pan, about two inches. When these liquors are well mixed in the pan, enter the yarn, light the fire, and bring the liquor to boil in about one hour; then take the yarn out, wring it without washing, and hang it to dry as in the former operation.

Third Operation.

This operation the same as the second in every respect.

Fourth Operation.

For every ten pounds of yarn make a clear ley from half a pound of pot or pearl ashes. Pour the ley into the boiling-pan, and add as much clear water as will be sufficient to boil the yarn for two hours; then enter the yarn, light the fire, and bring it to boil in about an hour. Continue it boiling about an hour, then take the yarn out, wash it very well in clear water, wring it, and hang it to dry as in former operations.

N. B. This operation is to cleanse the yarn from any oleaginous matter that may remain in it after boiling in the soap and dung liquors.

Fifth Operation.

To every gallon of iron liquor* add half a pound of ruddle or red chalk (the last the best) well pulverized.

Mix them well together, and let the liquor stand four hours, in order that the heavy particles may subside; then pour the clear liquor into the boiling pan, and bring it to such a degree of heat as a person can well bear his hand in it; divide the yarn into small parcels, about five banks in each; soak each parcel or handful very well in the above liquor, wring it, and lay it down on a clean deal board. When all the yarn is handed through the liquor, the last handful must be taken up and soaked in the liquor a second time, and every other handful in succession till the whole is gone through; then lay the yarn down in a tub, wherein there must be put a sufficient quantity of ley made from pot or pearl ashes, as will cover it about six inches. Let it lie in this state about two hours, then hand it over in the ley, wring it, and lay it down on a clear board. If it does not appear sufficiently deep in colour, this operation must be repeated till it has acquired a sufficient degree of darkness of colour: this done, it must be hung to dry as in former operations.

N. B. Any degree of red or yellow hue may be given to the yarn by increasing or diminishing the quantity of ruddle or red chalk.

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* Iron liquor is what the linen printers use.

Sixth Operation.

For every ten pounds of yarn make a ley from half a pound of pot or pearl ashes; pour the clear ley into the boiling-pan; add a sufficient quantity of water thereto that will cover the yarn about four inches; light the fire, and enter the yarn, when the liquor is a little warm; observe to keep it constantly under the liquor for two hours; increase the heat regularly till it come to a scald; then take the yarn out, wash it, and hang it to dry as in former operations.

Seventh Operation.

Make a sour liquor of oil of vitriol and water; the degree of acidity may be a little less than the juice of lemons; lay the yarn in it for about an hour, then take it out, wash it very well and wring it; give it a second washing and wringing, and lay it on a board.

N. B. This operation is to dissolve the metallic particles, and remove the ferruginous matter that remains on the surface of the thread after the fifth operation.

Eighth Operation.

For every ten pounds of yarn dissolve one pound of best white soap in clear water, and add as much water to this liquor in your boiling-pan as will be sufficient to boil the yarn for two hours. When these liquors are well mixed light the fire, enter the yarn, and bring the liquor to boil in about an hour. Continue it boiling slowly an hour; take it out, wash it in clear water very well, and hang it to dry as in former operations: when dry it is ready for the weaver.

N. B. It appears to me, from experiments that I have made, that less than four operations in the preparation of the yarn will not be sufficient to cleanse the pores of the fibres of the cotton, and render the colour permanent.

No. 85.

Observations on the Employment of Platina in Porcelain Painting. By Professor KLAPROTH.*

IN the course of half a century since platina was introduced and known in Europe, the experiments made with it by various eminent chemists seem to have exhausted every thing that relates to the physical and chemical properties of this remarkable metal. The imperfect information, however, which relates to its mineralogical and natural history seems to require further investigation, though it must at the same time be acknowledged that our information in this respect appears to be worthy of confidence, as the Spanish government has entrusted the inspection and management of its mines in South America to men who to a knowledge of mineralogy and mining unite great zeal for the improvement of these sciences.

The real origin of platina is in all probability to be ascribed to revolutions which have taken place in the Cordilleras by volcanoes, earthquakes, and inundations; and it is not improbable that these mountains still contain in their interior parts entire veins of platina, the discovery of which is perhaps reserved for future times.

At present, Peru is the only known country where platina is found, and particularly the district of Choco, where it is collected in the valleys between the mountains and rivers along with the gold in small laminæ, or it is obtained by washing the earth.* When the largest grains of gold have been picked from the mixed mass of gold and platina, the remaining gold is extracted by amalgamation; by means of which operation the platina is left behind in the form of flat plates or scales.

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* Tilloch, vol. 17, p. 135. From Scherer's *Allgemeines Journal der Chemie*, no. 52, 1802.

The deceptions formerly practised by mixing gold with platina have induced the Spanish government to prevent the exportation of it, and to give orders to all their servants in that country to keep the platina by them, and to wash it in water from time to time. But as means have been found to detect easily and in a certain manner the adulteration of gold with platina, and also to employ it for valuable purposes, it is to be hoped that the Spanish government will not persist in causing a prohibition so injurious to the arts and to its own finances to be executed with the former severity.

My object at present is not to enlarge on the chemical and physical properties of platina, but only to offer a few observations on the uses in the arts to which it has hitherto been applied; and then to give an account of the result of an experiment which I made in regard to a new application of this metal to objects of manufacture.

The apparent infusibility of platina by itself, formerly considered as an insuperable obstacle, was sufficient to prevent the employment of it except in combination with other metals, as experience showed that it was capable of uniting with the greater part of them by fusion. Of such mixtures, that arising from a combination of brass and platina was found to be exceedingly proper for the specula of reflecting telescopes, as this alloy was susceptible of a beautiful polish not subject to be injured by the prejudicial influence of the atmosphere and of moisture. At first, however, the employment of platina was not extended further until the experiments made known by Morveau, Sage, and other chemists, and afterwards prosecuted on a larger scale by count Von Sickingen, formed as it were an epoch in the history of this metal, and showed in what manner platina might be freed from its foreign particles, be welded, hammered, and drawn out into wire, so as to be applicable to a variety of purposes.

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* Platina is found in Spain, and also in St. Domingo.

It was, however, not yet possible to employ it in cases which required an actual fusion for the purpose of casting it; because this metal, in its purified state, was always by itself infusible in a common furnace. It was therefore a discovery of great importance to find that platina may be rendered fusible by arsenic; and that when mixed with this substance it may be cast in moulds, while the volatile metal employed as a flux may be again driven off by heat, so that the cast platina may then be hammered like any other metal. By employing this method, first made known by my worthy colleague M. Achard, vessels and articles of various kinds are made of platina, and particularly at Paris.

Bergman, however, had shown that platina which could be reduced to a state of fusion only by employing a large burning mirror, might be fused also by means of oxygen gas. In this manner M. Pelletier, by means of phosphoric glass, made from bones, combined with charcoal powder, brought large masses of platina to a state of complete fusion.

How far platina might be employed in porcelain painting has never yet, as far as I know, been examined: I therefore thought it of considerable importance to make some experiments on this subject, which did not deceive my expectation; but, on the contrary, convinced me that this object, in the hands of an ingenious artist, may be brought to perfection.

Gold and silver have hitherto been the only metals susceptible of being employed in their metallic form in painting and ornamenting porcelain, glass, and enamel. Gold answers this purpose so completely, that nothing further can be wished for on this head; whereas silver does not answer so well. As it possesses less density and is more porous than gold, it does not cover the ground so completely when applied to porcelain in thin leaves. The second cause of the inferiority of silver when employed in painting on porcelain arises from its nature, in consequence of which, when exposed to sulphureous and other phlogistic vapours, it becomes tarnished, loses its metallic splendour, and at length grows black. This inconvenience renders silver unfit for being employed in fine porcelain painting, and confines the application of metallic substances in this manner to gold alone.

Platina, in this respect, may be classed next to gold; and by its white colour may supply the place of silver without possessing any of its faults. It is not only capable, on account of its density and weight, in which it exceeds gold, of covering the ground completely, without leaving any perceptible interstices, as silver does; but it withstands like gold all the variations of the atmosphere, as well as sulphureous and other vapours.

The process which I employ in the application of platina to painting on porcelain is simple and easy: it is as follows:—I dissolve crude platina in aqua regia, and precipitate it by a saturated solution of sal ammoniac in water. The red crystalline precipitate thence produced is dried, and being reduced to a very fine powder is slowly brought to a red heat in a glass retort. As the volatile neutral salt, combined with the platina in this precipitate, becomes sublimated, the metallic part remains behind in the form of a gray soft powder. This powder is then subjected to the same process as gold; that is to say, it is mixed with a small quantity of the same flux as that used for gold, and being ground with oil of spike is applied with a brush to the porcelain; after which it is burnt in under the muffle of an enameller's furnace, and then polished with a burnishing tool.

The colour of platina burnt into porcelain in this manner is a silver white, inclining a little to a steel gray. If the platina be mixed in different proportions with gold, different shades of colour may be obtained; the gradations of which may be numbered from the white colour of unmixed platina to the yellow colour of gold. Platina is capable of receiving a considerable addition of gold before the transition from the white colour to yellow is perceptible. Thus, for example, in a mixture of four parts of gold and one of platina, no signs of the gold were to be observed, and the white colour could scarcely be distinguished from that of unmixed platina: it was only when eight parts of gold to one of platina were employed that the gold colour assumed the superiority.

I tried, in the like manner, different mixtures of platina and silver; but the colour produced was dull, and did not seem proper for painting on porcelain.

Besides this method of burning-in platina in substance on porcelain, it may be employed also in its dissolved state; in which case it gives a different result both in its colour and splendour. The solution of it in aqua regia is evaporated, and the thickened residuum is then applied several times in succession to the porcelain. The metallic matter thus penetrates into the substance of the porcelain itself, and forms a metallic mirror of the colour and splendour of polished steel.*

No. 86.

Extract of a Memoir read in the French National Institute, on the Strength of the Flax of New Zealand, compared with that of the Filaments of the Aloe, of Hemp, Flax, and Silk. By C. Labillardiere.†

THE flax of New Zealand, which, as is well known, is obtained from a plant of the family of the asphodela, called *Phormium tenax*, holds the first rank among the vegetable fibres, yet known, proper for the making of ropes. This fact was first made known by the celebrated Captain Cook and his illustrious fellow-navigator Sir Joseph Banks. It was afterwards confirmed by Dr. Forster, who gave a good description of the plant, which he found growing in full vigour during various excursions in New Zealand, at several parts of which he touched when he accompanied Captain Cook on his second voyage round the world. A good figure of the plant may be seen in the first volume of the account of that voyage, and also in Miller's *Icones Plantarum*. Dr. Forster has described all the parts of fructification, and illustrated them with figures, in his work on the new genera of plants discovered in the South Seas.

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* At the time this paper was read in the Royal Academy of Sciences, the author exhibited several patterns of porcelain ornamented in this manner, which had been made in the royal observatory.

† Tilloch, vol. 17, p. 341.

No person, however, has ever yet attempted to ascertain how far the fibres of the *Phormium tenax* are superior in strength to those of hemp. This is the object of the present memoir, in which I shall compare their strength with that of the filaments of the aloe, of flax, and of silk. It is of the more importance to examine the strength of the flax of New Zealand, as compared with that of hemp in particular, because it might be substituted for the latter with great advantage in the navy, whereas the other substances are too scarce and too dear, or much inferior in quality.

The flax of New Zealand, which I submitted to examination in order to ascertain its strength, was given to me in exchange for toys by some of the inhabitants of that extensive country, with whom we had an intercourse, towards its northern point, during the voyage undertaken in search of Perouse; Ventose 22d, 1st year of the republic. The plant which produces it is of great use to these savages; and when they approached us, the first articles they exhibited were large handfuls of its leaves prepared for various purposes. Even when at a considerable distance from us they waved them with a sort of enthusiasm, as if desirous to make known to us their value, and we soon found that we had properly understood this kind of language, for they set a very high price on them when they got on board our vessel.

For my experiments I preferred these filaments to those produced from the leaves of the same plant raised in green-houses, where the fibres certainly do not acquire so much strength as in the open air; besides, the season proper for collecting leaves capable of giving the strongest fibres can be known only by experience.

The apparatus I employed for ascertaining the strength of the different fibres which I subjected to trial consisted of two pieces of wood, ten inches in height, fixed on a plank in a vertical direction, at the distance of six centimetres, or 2.598 inches from each other; they were slightly rounded at the upper extremity, and on the exterior part of each was fixed a small iron cylinder, about a millimetre in diameter. To these two small cylinders I affixed the filaments the strength of which I intended to try. They rested on each side on the rounded extremities of the pieces of wood already mentioned. I took the precaution to employ fibres of the same diameter, that is one-tenth of a millimetre or 0·0443 of a line, which I verified by means of a microscope and a good micrometer, taking care to twist equally the part of the filament which I examined, having chosen it as far as possible of the same dimensions throughout its whole length. I tried the strength of it from every eight centimetres to eight centimetres, or every two inches 11.464 lines, which was the distance between the pieces of wood, and I suspended from about the middle of it, by means of a wire hook well covered with hemp, a weight which I increased until the filament was broken.

I took care that it should not be twisted, in order that I might ascertain its whole strength, for without this precaution it would have broken, as is well known, much sooner. Besides, for many reasons which it would be superfluous to mention here, I should have obtained results much less certain; and it is needless to observe that, in such cases, a rigorous determination cannot be obtained, but merely an approximation.

After having tried the strength of twelve lengths of hemp, as above described, and having divided the sum by that number, to ascertain the mean strength of each, I found that it was equal to sixteen and one-third, while that of the fibres of the *Phormium tenax,* tried in the same state, was twenty-three and five-elevenths. The filaments of the aloe gave only seven, flax eleven and three-fourths, and silk thirty-four; or, in other words, the fibres of hemp broke only with a weight of 400.3917 grammes, that of the flax of New Zealand by 590.5034 grammes, flax by 295.8228 grammes, and silk by 855.9978 grammes.

The hemp and flax which I employed for these experiments were the first fibres of the best kind produced in the department of L'Orne. I extracted, by maceration and slight friction to detach the parenchyme, the fibres of the aloe from a leaf of the *Agave fœtida,* Linn. or the *Furcræa gigantea* Vent. which was given to me by my colleague C. Thouin.

I must here observe, that at first I took the filaments of a diameter much smaller, one twentieth of a millimetre, or 0.0221 of a line, and even less; but I soon observed that it was difficult to obtain them of that tenuity without a great many inequalities and other defects, which prevented the exactness of the results; besides, the more delicate they were, the more difficult it was to ascertain their diameter. I paid attention, therefore, to those only the diameter of which was one-tenth of a millimetre.

It may, therefore, be readily conceived what advantage it would be to the navy to have ropes, the strength of which, were it confined merely to this proportion, would be almost one-half greater than that of hemp ropes. But I have no hesitation to assert that it will far exceed it; for the fibres of the flax of New Zealand, according to a series of comparative experiments which I made on purpose to determine the tension of which they are susceptible before they break, are more tensible by one-half than those of hemp; and the principal cause of the diminution of the strength of a rope, in proportion to its being more twisted, arises in particular from the fibres of which it is composed experiencing different degrees of tension, the strength and inequality of which are increased by torsion. But it is evident that the more the fibres which enter into a rope are susceptible of tension, the less is the difference in the distribution of their strength, whence it results that the most tensible fibres, *cæteris paribus*, will always make the best ropes.

It has been observed that certain kinds of hemp, with stiff, but very strong fibres, are often capable of less resistance, when employed to make ropes, than other kinds, the fibres of which are weaker, but softer and more flexible. It is besides known, that stiff fibres break by a weak degree of torsion, which is resisted by those that have more flexibility.

To ascertain the tensibility of the fibres of the flax of New Zealand, I took six of one-tenth of a millimetre, or 0.0443 line in diameter, and suspended to lengths of fourteen centimetres, or five inches 2.062 lines, a weight which I gradually increased, examining by what quantity they were extended before they broke. The sum of these quantities, divided by the number of the filaments subjected to trial, gave for quotient the mean term of the tensibility of each. Having subjected to the same trial the filaments of the aloe, of hemp, of flax, and of silk, the results which I obtained were: for the flax 1.1279 millimetres; for the hemp 2.2558; for the flax of New Zealand 3.3837; for the aloe 5.6395; and for the silk 11.2790: so that the tensibility of flax being equal to half that of hemp will be expressed by 1; that of the *Phormium tenax* by one and an half; that of the filaments of the aloe by two and a half; and that of silk by five. It is thence seen what prodigious power of resistance is exhibited by a few threads of silk, carefully spun, as their very great tensibility causes them all to make an effort nearly equal before they yield to the effort made to break them.

It may not be improper here to remark, that the Chinese, who make great use of silk strings for their musical instruments, have no doubt found that twisting them for that purpose hurts their strength, and also the justness of the sound, for they are manufactured without twisting; the threads of which they are composed being merely united by means of an elastic resin: on this account they are, on the first view, taken for catgut. I have no doubt that if our artists would attempt this new manufacture, their labours would be attended with success, especially as they employ with great dexterity various kinds of elastic resin; but that extracted from the *Vahe* of Madagascar, (*Vahea elastica,*) would be preferable to caoutchouc, which comes from Guyana, because the latter has a very dark tint, while the other inclines very much to a white colour. It readily dissolves, as is well known, in ether. Besides gum elastic extracted from several other vegetables might also be employed for the same purpose.

The *Phormium tenax* is far from being the only plant of the division of the monocotyledons, capable of furnishing filaments proper for the uses of rope-making; for besides some gramineous plants, most of the palms, and all the species of the Agave, &c. there are many others of this great division which have not yet been employed, and which might be turned to advantage, particularly several kinds of iris, the leaves of which possess very great strength.

I must here observe, that in most plants of the division of the monocotyledons, the leaves produce the filaments proper for the purposes of rope-making; and the disposition of their fibres, which is nearly parallel throughout the whole length of the leaves, will call to the remembrance of botanists the excellent memoir of our colleague Desfontaines, on the organization of the monocotyledon plants. On the other hand, in the division of the dicotyledons, the filaments employed for ropes is obtained from the bark; and it is well known, that among the great number of sections which these vegetables contain, they are found chiefly in those of the *Thymeli, Urticæ, Malvaceæ, Tiliæ*, and the *Amentaceæ*. The bark of a shrub of the first section (of a new kind of *Pimelea*) produces filaments which I have seen the inhabitants of Cape Van Diemen employ for the purpose of making ropes. These savages have so little industry, that they use them without the least preparation. They even take no advantage of a very excellent kind of flax which grows spontaneously on their coasts. The crude bark of the *Pimelea* abovementioned formed the handles of some baskets made of reeds, which the women at the hours of repast filled with shell-fish, diving in the sea to considerable depths, at the risk of being devoured by sharks, or of being detained at the bottom of the water by marine plants, some of which, and particularly the *Ficus pyriferus*, are several hundreds of feet in length.

They employed this bark also for fastening round their bodies the skin of the kangaroo, the only clothing worn by the best dressed of these savages; for several of them were entirely naked, though exposed to severe cold in the latitude of forty-four degrees south, and by a very strange kind of whim this vestment served only to cover the shoulders.

The *Phormium tenax* will succeed perfectly in France, for it is found in New Zealand from latitude thirty-four degrees to latitude forty-seven degrees south, and is exposed there to very severe frosts in the most southern part of that very large country. Moist places are better suited to it than dry, and the same may be said of most of the other *Lilacæi.* It would thrive well in many of the marshy districts, which at present are considered as useless; besides, it is a lively plant, and will require very little care. It may readily be conceived what advantages must result from the culture of this valuable plant, and particularly to the navy, as it will lighten in a very considerable degree the lading of our vessels, for the weight of the rigging in a 74-gun ship is estimated at 1714.005 myriagrammes, or sixty-eight thousand pounds. The use of the flax of New Holland would lessen this weight more than one-half; and also that of the other ropes, which are above the line of flotation; and therefore the vessel would be capable of taking in a much greater quantity of provisions. Besides, it is well known that the less the diameter of the ropes above the line of flotation, the less will be the lee-way; and, therefore, these new ropes will contribute to accelerate the progress of ships of war, which will still be increased by the lightening they will experience when loaded with a less weight than usual. These ropes being smaller and lighter than those made with hemp, fewer hands will be required to manage them; so that, if introduced, ships will need fewer men than those rigged with hemp.

It is evident also that fibres so strong and so pliable will be proper for the fabrication of different kinds of cloth, and may be substituted with advantage in our manufactories for hemp and even flax. They will no doubt retain in the loom that superiority which they have in strength over hemp. Their whiteness and silky appearance give reason to hope that cloth made of them will exceed in beauty that manufactured from flax.

All the dresses which we purchased from the savages of New Zealand were made from the fibres of their flax. To cords of the same substance they had attached different ornaments, among which were pieces of human bones, and which were suspended on their breast as a kind of trophy. They seemed to attach great value to them, and were very unwilling to part with them.

Their fishing-lines were formed of two filaments twisted together; but their nets were made from the leaves of a plant separated into filaments, without any other preparation. As their nets are of prodigious extent, for the purpose of fishing at a great distance from the coast, these savages do not make them of ropes, because this labour would require much time, and they besides find that their flax employed in this manner is sufficient.

All the piroguas which approached us had on board men armed for the most part with stones, some of them of granite, and others of serpentine, which they had attached to their wrists with cords of the *Phormium tenax*; but I must observe that these were only defensive weapons, for they did every thing in their power to engage our confidence, and soon consented to exchange these weapons for our hatchets, and for other instruments of iron, on which these warlike people set great value.

It follows from the experiments, the results of which I have here given, 1st, that the strength of the fibres of the aloe being equal to seven; that of flax is represented by eleven and three-fourths; that of hemp by sixteen and one-third; that of the flax of New Zealand by twenty-three and five-elevenths; and that of silk by thirty-four.

But the quantity they stretch before they break is in another proportion; for that of the filaments of the aloe being equal to two and a half; that of flax is only one-half; that of hemp one; that of the flax of New Zealand one and a half; and that of silk five. 2d, That great advantages will result from the cultivation of the New Zealand flax in France, where it will thrive exceedingly well.

No. 87.

Description of a Method of preventing Injury to the Health of the Workmen employed in preparing White Lead. By Mr. ARCHER WARD.*

(With an engraving.)

IN order to explain, as well as I can, the advantage that will accrue to the workmen by adopting my invention, in preference to the common mode of preparing white lead, I will first state what the common mode is. When blue lead is in part corroded in the stacks, by an acid raised by a considerable degree of heat, brought on by horse-litter, the corroded and uncorroded lead are taken from the stacks to a room called the engine-loft, where a pair of iron rollers is fixed with a screen under them. The lead in this state is passed through the rollers and screen; from the motion of these rollers and screen, by which the white lead is separated from the uncorroded or blue lead, together with the moving the lead in order to its being passed through them, a very considerable quantity of fine dusty white lead is raised, which almost covers the workmen thus employed, and is very pernicious to them. And not only in this part of the process are they liable to be thus injured, but they are again exposed to the dusty lead, by removing the blue lead from the screen-house to the furnace, as there still remains a quantity of the fine particles of white lead, which of course rises in removing it; and also, in removing the white lead from under the screen to the grinding-tub, a quantity of the dust arises, which is very detrimental to the people so employed.

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* Repertory, vol. 5. p. 249. From the *Transactions of the Society for the Encouragement of Arts, &c.*—The gold medal of the Society was voted to Mr. Ward for this invention.

My invention removes all these difficulties respecting the dry dusty white lead, so very injurious to the health of the working people; and consists of a vessel, as shown in plate 13, fig. 1, twelve feet long, six feet wide, and three feet ten inches deep. In this vessel is fixed a pair of brass rollers in a frame, one roller above the other. The centre of the rollers is about ten inches below the top of the vessel; and, one inch lower, is a covering of oak boards or riddles, an inch thick, fixed in the inside of the vessel, in a groove, so as to be taken out occasionally: these boards are bored, with a centre-bit, as full of holes as may be, without danger of breaking into each other; the size of these holes is, in the machine at large, about five-eighths of an inch diameter. This being done, the vessel is filled with water, about three inches above the oak boards or riddles; the lower brass roller is now under water, and about half of the upper roller is under water also. Thus the lead coming from the stacks is put through the brass rollers in water, and, by raking the lead with a copper rake over the oak boards or riddles, the white lead passes through the riddles, and the blue lead remains above; which, being taken out, is thrown upon an inclined plane of strong laths to drain, where it remains about twelve hours, when the blue lead is ready for the furnace to be remelted; by this means no dusty white lead can rise in any part to the work-people. No such plan as this (although long desired) has, to my knowledge, been put in execution, so as to answer all the purposes above stated. It may be asked, why the lead in the common mode is not made wet before it is passed through the rollers and screen. Should this be done, the lead would be a paste on the rollers and screen, and the white lead prevented separating from the blue lead, which is absolutely necessary in the preparation of white lead.

Reference to the Engraving, Plate 13.

FIG. 1, A, an inclined plane of wood, on which the white and blue lead is placed immediately from the stacks, and thus introduced between the brass rollers **BB.**

CC, the vessel containing water.

DDD, the pierced oak boards or riddles, which, by being made to slide in grooves in the sides of the vessel **CC,** may occasionally be taken out by removing the wooden bar *ee.*

E, a handle or winch, which, in the machine at large, may be a wheel communicating to mill-work, and thus turn the rollers **BB.**

F, a pinion, fixed on the gudgeon of the upper roller, and communicating with a similar pinion on the arbor of the lower roller, keeping both of them in motion by the turn of the handle. As it is necessary that the upper roller should be at liberty to rise or fall, in order to give a due degree of pressure to the lead in passing between the rollers, two weights **GG,** with proper stems to them, (as shown more at large in fig. 2,) are placed over the gudgeons of the upper roller, thereby keeping a due degree of pressure; and, if any piece of the lead should be thicker than usual, admitting the roller to give way to it, and thereby preventing any injury to the machinery.

H, a notch in one side of the wooden vessel, serving to regulate the depth of the water on the riddles DDD.

The foregoing description is accompanied by two certificates; one from Mr. Samuel Walker Parker, stating that many tons of white lead have been made, in the manner above described, at the manufactory at Islington belonging to Walker, Ward, and Co. and that, since Mr. Ward's plan was adopted, no other method has been used. The other certificate is from Mr. H. Browne, of Irongate, Derby; who says that he thinks the foregoing invention a very valuable improvement in preparing white lead, and that the quality of the lead is not in the least injured by it.

No. 88.

Description of an improved Mill for levigating Painters' Colours. By Mr. James Rawlinson.*

(With an engraving.)

THE hitherto very unmechanical, inconvenient, and highly injurious method of grinding poisonous and noxious colours, led me first to imagine a better might easily be contrived for that purpose. It must be obvious to every person, that the method hitherto adopted of grinding colours on an horizontal marble slab, with a small pebble muller, requires the body of the person who grinds to bend over that slab, and consequently his head; which causes him constantly to inhale the noxious and poisonous volatile parts of the paint, which is not unfrequently ground with oil saturated with litharge of lead; and if we may judge from the very unhealthy appearance of these men, accustomed to much colour-grinding, it should seem the bad effects of this employment require a speedy remedy.

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* Nicholson, vol. 11, p. 119. From the *Memoirs of the Society of Arts* for 1804.—The Society awarded him the silver medal.

The machine, of which I now send the Society a model, has not only the advantage of being an effectual remedy of this extensive and severe evil to recommend it, but it grinds the colour much easier, much finer, and much quicker, than any method hitherto adopted. Having occasion for a considerable quantity of colour-grinding in the profession in which I am engaged, and that in the finest state possible, and having made use of this machine for several years, and being more and more convinced of its utility, I thought it my duty to present it to the Society of Arts, hoping that it might not be altogether unworthy of their attention. The roller of the machine that I use is sixteen inches and a half in diameter, and four inches and a half in breadth. The concave muller that it works against covers one third of that roller: it is therefore evident, that with this machine I have seventy-two square inches of the concave marble muller in constant work on the paint, and that I can bring the paint much oftener under this muller in a given space of time, than I could by the usual method with the pebble muller, which is seldom more than four inches in diameter, and consequently has scarcely sixteen square inches at work on the paint, when my concave muller has seventy-two. I do not mean to say that a roller, the size of that which I now use, is the largest which might be employed; for truly I believe that a roller two feet in diameter, with a concave muller in proportion, would not be hard work for a man; and then the advantage to the public would be still farther increased.

This machine will be found equally useful for the colours ground in water, as for those ground in oils; and I doubt not but the great importance of this simple machine will be very soon generally experienced in all manufactories where colours are used. The labour necessary with this machine, in grinding colours exceedingly fine, is very easy. It is useless to enter into any minute description in this place, as a bare inspection of the machine must sufficiently explain itself.

To the colourman it would evidently be an essential saving of labour, and consequently of expense, which will probably have some weight as a recommendation; and the advantages to the colour-grinder have been already stated.

Reference to the Engraving. Plate 13, Fig. 3.

A is a roller or cylinder made of any kind of marble; black marble is esteemed the best, because it is the hardest, and takes the best polish. B is a concave muller covering one-third of the roller, of the same kind of marble, and fixed in a wooden frame *b*, which is hung to the frame E at *ii*. C is a strong piece of iron, about an inch broad, to keep the muller steady, and is fixed to the frame with a joint at *f*. The small binding-screw, with the fly-nut, that passes through the centre of the iron plate at *c*, is for the purpose of laying more pressure on the muller, if required, as well as to keep it steady. D is a taker-off, made of a clock-spring about half an inch broad, and fixed in the manner of a frame-saw, in an iron frame *k*, in an inclined position to the roller, and turning on pivots at *dd*. G is a slide-board to draw out occasionally, to clean, &c. if any particles of paint should fall from the roller, and which also forms itself for the plate

H, to catch the colour on as it falls from the taker-off. F is a drawer, for the purpose of containing curriers' shavings, which are the best things for cleaning paint-mills.—E is the frame.

Previous to the colour being applied to the mill, I should recommend it to be finely pulverized in a mortar, covered in the manner of the chemists when they levigate poisonous drugs.* This process of dry-grinding is equally necessary for the marble slab now in use; after which it should be mixed with oil or water, and with a spatula or pallet-knife put on the roller, near to the top of the concave muller, and the roller turned round, which takes the colour under the muller without any difficulty, and very few turns of the roller spread it equally over its surface. When it is perceived sufficiently fine for the purpose required, it is very easily taken off by means of the taker-off described, which must be held against the roller, and the roller turned the reverse way, which cleans it very quick and very completely; and the muller will only require to be cleaned when you desist or change the colour. It is then turned back, being hung on pivots to the frame at *i i*, and cleaned with a pallet-knife or spatula very conveniently. Afterwards, a handful of curriers' shavings held on the roller, with two or three revolutions cleans it effectually; and there is less waste with this machine than with any marble slab.

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* Or rather in an improved mill, used at Manchester by Mr. Charles Taylor, for grinding indigo in a dry state, of which I have annexed a drawing, and reference, to render the whole business of colour-grinding complete.—*Note of the Author.*

This is the same apparatus as was used under the name of *a philosophical mill*, in the laboratory at Gottorp, about the beginning of the last century. See the memoir of Dr. Joel Langelot, with an engraving, in Lowthorp's Abridgment of the Philosophical Transactions, vol. 3, p. 318.—Nicholson.

As to the quantity ground at once on this mill, it must be regulated by the state of fineness to which it is required to be ground. If it is wanted to be very fine, a smaller quantity must be put on the roller at a time; and as to time requisite for grinding a given quantity of colour, this will also depend on the state of fineness to which it is ground. I have observed that my colour-grinder has ground the quantity of colour which used to serve him per day, with this machine, in three hours, and, as he said, with ease. The colour also was much more to my satisfaction than in the former way, and attended with less waste.

I have mentioned the pulverizing the colours in a covered mortar, which would prevent waste, and prevent the dust and finest parts of noxious colours from being injurious to the grinder. In some manufactories, where large quantities of colours, prepared from lead, copper, and arsenic, are used, this precaution is particularly necessary. I do not mean to say that my machine is intended to supersede the paint-mill now in use for coarse common colours. It is intended for no such purpose; but to supersede the use of the very awkward and unmechanical marble slab now in use, and on which all the colours for china manufactories, coach-painters, japanners, and colour-manufacturers for artists, &c. are now ground.

Several of the colour-manufacturers have expressed to me their great want of such a machine; and that I had no desire of troubling the public with a machine that would not answer, is evident, from my having used it several years before I presumed to recommend it to their attention. Being therefore now completely convinced of its utility, and hoping that it might relieve a number of my fellow-creatures from a dangerous employment, I have ventured to commit it to the protection of the Society of

Arts; hoping, through their means, to see its ultimate success. And, further to give the Society the most complete assurance in my power, I have annexed the opinion of a very ingenious and mechanical friend of mine who has frequently seen it work. If any other questions should occur to the Committee, that may be in my power to explain, I shall gladly do so. I am, &c.

JAMES RAWLINSON.

Derby, February 6, 1806.
To CHARLES TAYLOR, Esquire.

P. S. When the colour is ground, I recommend the following mode of tying it up in bladders, in preference to the usual method. Instead of drawing the neck of the bladder close, in the act of tying it, insert a slender cylindrical stick, and bind the bladder close around it. This, when dry, will form a tube or pipe, through which, when the stick is withdrawn, the colour may be squeezed as wanted, and the neck again closed by replacing the stick. This is not only a neater and much more cleanly mode than the usual one of perforating the bladder; and stopping the hole with a nail, or more commonly leaving it open, to the prejudice of the colour; but the bladder, being uninjured, may be used repeatedly for fresh quantities of colour.

N. B. The barrel of a quill may be tied, in place of the stick, into the neck of the bladder, with its closed end outwards, which will keep the colour secure in travelling, and when used, the end of the quill being cut off, it may afterwards be closed by a stick.*

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* A certificate from Mr. Thomas Swanwick, of Derby, and also from Mr. John Middleton, of St. Martin's Lane, confirming the above statement, accompanied these papers.

Reference to the Engraving (Plate 13) of an improved Mill for grinding Indigo, or other dry Colours.

Fig. 4. L represents a mortar made of marble or hard stone; one made in the common way will answer. M, a muller or grinder, nearly in the form of a pear, in the upper part of which an iron axis is firmly fixed, which axis, at the parts NN, turns in grooves or slits, cut in two pieces of oak projecting horizontally from a wall, and when the axis is at work, are secured in the grooves by iron pins, OO. P, the handle, which forms a part of the axis, and by which the grinder is worked. Q, the wall in which the oak pieces NN are fixed. R, a weight which may occasionally be added, if more power is wanted.

Fig. 5, shows the muller or grinder, with its axis separate from the other machinery; its bottom should be made to fit the mortar. S is a groove cut through the stone.

On grinding indigo, or such substance, in a dry state, in this mill, the muller being placed in the mortar, and secured in the oak pieces by the pins, the indigo to be ground is thrown above the muller into the mortar; on turning the handle of the axis, the indigo in lumps falls into the groove cut through the muller, and is from thence drawn under the action of the muller, and propelled to its outer edge within the mortar, from whence the coarser particles again fall into the groove of the muller, and are again ground under it; which operation is continued, till the whole of it is ground to an impalpable powder; the muller is then easily removed, and the colour taken out.

A wood cover, in two halves, with a hole for the axis, is usually placed upon the mortar, during the operation, to prevent any loss to the colour, or bad effect to the operator.

No. 89.

The Process for refining Lead, as practised in England. In a Letter from Mr. John Sadler.*

(With two engravings.)

MY dear Sir—Citizen Duhamel, in his Memoir on the Refining of Lead in the large way, has given a sketch of the process used in England; if you think the following more detailed description will be acceptable to the readers of the Philosophical Journal, it is at your service.

The object of refining lead is not merely on account of the silver it contains, but to procure it as free as possible from the other metals with which it is usually alloyed, and to procure litharge. The silver is only an object so far as it helps to pay the expense of refining.

The lead produced at the smelting hearths or furnaces in England is never perfectly pure; it is always alloyed with a portion of silver, and most commonly with one or most of the following metals; namely, zinc, antimony, copper, and arsenic; which render it unfit for some of the purposes to which lead is applied.

The operation of refining is founded on the facility with which lead is oxidated when exposed to heat in contact with atmospheric air, and the peculiar properties the oxides of lead possess; being easily fused, and in that state oxidating and combining with most of the metals; gold, silver, and platina excepted.

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* Nicholson, vol. 15, p. 1.

The lead to be refined is exposed to the action of heat and air upon a *cupel* or *test*, composed of a mixture of bone and fern ashes in a reverberatory furnace; the description of which, with the different manipulations, are as follows:

The refining furnace is composed of good solid masonry, bound together with iron bolts. It differs very little in its construction from the common reverberatory furnace, except the bottom, which is perforated to receive the test or cupel.

Fig. 1, plate 14, is a perspective view of the furnace with its iron work; *a* the teazing hole, *b* aperture by which the test is supplied with lead, *c* an arch or dome over the feeding hole, communicating with the furnace stack by a flue, *d* area or space where the test is taken in and out the furnace, *ee* two strong iron bars to support the test when in its place, *f* cast-iron pot set in masonry, the flue passing into the stack of the furnace, *g* the stack, *p* the ash pit, *q* an iron bar to slide the ladle on when feeding the test.

Fig. 2, a perpendicular section of the furnace showing the test *i*, supported in its place under the opening of the bottom of the furnace by the two wedges *rr*; *k* aperture for the nozzle of the bellows, *s* fire bar resting on the bearers.

Fig. 3, plan of the interior of the furnace; *l* part of the bellows, *hh* flues from the body of the furnace to the stack.

The same letters in the different plans are meant to denote the same parts.

Plate 15, fig. 1, plan of the iron frame into which the mixture of bone and fern ashes is rammed to form the test.

This frame is something larger than the elliptical hole in the bottom of the furnace.

Figs. 2 and 3, plan and section of the test; *m* the part which contains the lead to be refined, *n* breast of the test, *oo* small gutters or channels through which the litharge flows, *p* a semi-eliptical hole for the litharge to fall through from the gutters upon the area of the refinery.

These drawings and references will be sufficient to make the description of the furnace, &c. clearly understood.

Of the Test or Cupel.

A good test is of the first importance in refining; the method of constructing one I shall endeavour to point out. Six parts of well burnt bone ashes and one part of good fern ashes are to be well mixed, sifted through a sieve, (the spaces in which are about one-eighth of an inch square,) and moistened to about the same degree the founders use their sand. The iron frame is to be laid on the floor and made steady, with wedges under its rim; about two inches in thickness of the ashes are to be equally spread over the bottom, and with an iron beater, such as used by the founders, equally rammed between the cross bars; the frame is to be again filled and rammed all over, beginning at the circumference and working spiral ways until finished in the centre, the filling and ramming to be repeated until the frame is completely full; an excavation to contain the lead is made as expressed in the plan, with a sharp spade about five inches square, the edges dressed with a long-bladed knife; a semi-eliptical hole, as at *p*, is to be cut through the breast. Having proceeded so far, the test is to be turned on its side and dressed from all superfluous ashes adhering to the bottom, taking care that none shall be left flush with the bottom of the frame or cross bars, otherwise in fixing the test to its situation at the bottom of the furnace it would be liable to be bulged.

Fixing the Test in its situation.

THE rim of the test is now to be plastered with clay or moistened ashes, placed upon the supporting cross bars, and fixed with wedges firmly against the bottom of the furnace, the breast next to the feeding hole.

A gentle fire may now be lighted, and gradually increased until the test be red hot. When it ceases to emit steam from the under side it is sufficiently dry.

Lead previously melted in the iron pot *f* is ladled into the test until the hollow part be nearly filled, the operator closes the feeding aperture, and increases the heat of the furnace until the surface of the lead is well covered with litharge; he then removes the door from the feeding hole, and with an iron rod, which has one end bent down at right angles about three inches and made flat or chissel-shaped, scrapes the small gutter or channel *o* until the litharge just flows into it, the blast from a pair of double bellows is then directed from the back part over the surface of the test, the litharge is urged forward, and flows from the gutter upon the floor of the refinery; the operation now goes forward, gradually adding lead as the escape of litharge makes necessary, until the gutter is so worn down that the test does not contain more than an inch in depth of lead, the blast is then taken off, the gutter filled up with moistened ashes, and a fresh one made on the other side the breast; the test is again filled, though not so full as at first, and the operation carried on until this gutter also is worn down and the test contain from about fifty to seventy pounds of alloy. This quantity is run into an iron pot, and set by until a sufficient number of pieces have been collected to make it worth while to take off a plate of pure silver from them.

The quantity of alloy left in the working off each test must depend in a great measure upon the quantity of silver it by estimation is supposed to contain. A sufficient quantity of lead should always be left in the alloy to make it fuse easily in the iron pot.

When the test is removed from the furnace and broken up, the litharge will be found to have penetrated to an inconsiderable but equal depth in the ashes; that part not impregnated with litharge may be pulverised, mixed with fresh ashes, and again used for another test.

The operation of taking off the silver pure differs in no respect from the foregoing, only more care is observed in the working, not to suffer the escape of any metallic particles with the litharge, as that would occasion considerable waste of silver. As the process advances, and the proportion of silver to lead increases, the litharge assumes a darker colour, a greater heat becomes necessary, and at last the brightening takes place; the interior of the furnace, which during the whole of the process had been very obscure and misty, clears up. When the operator observes the surface of the silver to be free from litharge, he removes the blast of the bellows, and suffers the furnace to cool gradually; as the silver cools many protuberances arise on the surface, and fluid silver is ejected from them with considerable force, which falling again on the plate spots it very fantastically with small globules.

The latter portions of litharge bring over a considerable quantity of silver with them; this is generally reduced by itself and again refined.

The litharge as it falls upon the floor of the refinery is occasionally removed; it is in clots at first, but after a short time as it cools it falls for the most part like slacked lime, and appears in the brilliant scales it is met with in commerce: if it is intended as an article for sale, nothing more is necessary than to sift it from the clots which have not fallen and pack it in barrels.

If, on the contrary, it is intended to be manufactured into pure lead, it is placed in a reverberatory furnace, mixed with clean small-coal, and exposed to a heat just sufficient to fuse the litharge. The metal as it is reduced flows through an aperture into an iron pot, and is cast into pigs for sale. During the reducing, care is taken to keep the whole surface of the litharge in the furnace covered with small-coal.

In some smelt works, instead of a reverberatory furnace for reducing, a blast furnace is made use of, on account of the greater produce, but the lead so reduced is never so pure as that made in the wind furnace. The oxides of the metals, which require a greater heat to reduce than the lead, are in the blast furnace generally reduced with it.

The volatile oxides, as zinc, antimony, and arsenic, are mostly carried off by evaporation during refining; a considerable portion of the oxide of lead itself is carried off by evaporation, making the interior of the furnace so misty and obscure that a person unused to refining cannot see more than a few inches into it.

A considerable portion of these oxides are driven by the blast of the bellows through the feeding aperture, and would be dissipated in the refining-house, to the great injury of the workmen's healths; to prevent their ill effects the arch or dome over the feeding hole is erected to carry the fume into the stack of the furnace.

NO. 90.

Description of Mr. G. ATKINS's *Hydrometer for determining the Specific Gravity of both Solids and Liquids.*[*]

(With an engraving.)

SIR—The present improved state of chemistry; its application to so many of our principal manufactures, and the necessity of determining the specific gravity of the various substances which are used in them, or affording in all cases an important indication with regard to their qualities, and being in many the only accurate measure of their value, may perhaps render the following description of an instrument for this purpose not unacceptable to your numerous readers.

By giving it a place in your valuable Magazine you will therefore oblige yours, &c.

GEORGE ATKINS.

To Mr. TILLOCH.
Fleet Street, September 10, 1808.

THE specific gravity, or comparative weight of the majority of those substances which fall under the observation of the manufacturer, the mineralogist, or the chemist, having always been considered as one of their most distinguishing characteristics, a variety of methods have at different periods been resorted to for ascertaining it.

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[*] Tilloch, vol. 31, p. 254.

In point of accuracy, perhaps, the best mode of taking the specific gravity of a body is by a very good hydrostatic balance. This instrument, however, we may venture to affirm, can scarcely ever be obtained sufficiently perfect to be depended on for so nice a purpose.

Persons who are in the habit of adjusting balances, and those who use them with considerable care, well know the various sources of error to which they are liable. The circumstance of the arms of a beam being in equilibrio, is no proof of its correctness, unless it will remain so when either loaded or unloaded, and with exchange of scale-pans. The necessity of having a piece of steel for the beam which shall be perfectly homogeneous; the uncertainty with regard to the exact equality of the arms, in both weight and length; and, even when very nicely adjusted, its liability to acquire polarity, and consequent derangement by magnetism; the expansion of either arm by the heat of the hand, or its contraction by a current of air, renders those instruments extremely liable to give anomalous results.

But supposing the balance not liable to error, it is too complicated in its use for any other than the man of science, in his closet, where time and close attention may be afforded; and since the application of science to the arts has become so general, chemists, manufacturers of acids, brewers, dyers, distillers, and all others whose manufacture consists of any cheminal process, require a more simple and expeditious mode of ascertaining the specific gravity, and consequently the value of their articles, than by the hydrostatic balance. Indeed, in many concerns its use would be impracticable, it being necessary to intrust the business of examining the qualities of the substances in question to persons who have neither time or knowledge sufficient to enable them to apply an instrument of such a kind.

The *hydrometer*, on a variety of constructions, has been long made use of by distillers and all dealers in spirituous liquors; and of late years brewers have generally adopted it, for its simplicity and facility in use compared with the hydrostatic balance or weighing bottle. But as the hydrometer for spirituous-liquors, and the saccharometer for malt-liquors, (which the author of this paper is in the habit of manufacturing,) are adapted solely to their respective purposes, he has long thought it a very desirable object to construct an instrument which would combine *simplicity* with an universality of application to all substances, fluid and solid, of which it might be requisite to ascertain the specific gravity. And it is presumed that this object is accomplished in the instrument about to be described.

Among the principal subjects of consideration in the construction of hydrometers, are, the form of the instrument which shall be best adapted to facilitate its motion in a fluid, and that it be of a convenient size, both for the sake of portability, and that it may require as small a sample of a fluid as possible to make an experiment with.

With these views, the spheroidical form is that which has been preferred for the bulb of this instrument, on account of its more readily dividing the fluid in its passage up and down; and the size of it is such, that half a pint of any liquid is sufficient for trial with it.*

The hydrometer (see plate 15, fig. 5) consists of the bulb *b*, a small stem *a c*, with a cup *d* on its top to receive weights, and a shank *e f* beneath the bulb with a pointed screw, to which is affixed a cup *g*, to receive weights or solids when their specific gravities are required to be taken.

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* The figure in the engraving of the Emporium is half the size of the original drawing.

The instrument is accompanied with an accurate set of grain weights.

The weight of the hydrometer itself is seven hundred grains, and on adding three hundred grains in the *upper cup*, and immersing it in distilled water, at the temperature of 60 degrees of Fahrenheit's thermometer, it will subside to the middle mark on the stem, and will then consequently displace one thousand grains of water.

It follows, therefore, from this adjustment of the bulk of the instrument, that each grain in the upper cup will represent one thousandth part of the specific gravity of the water, or one unit in specific gravity, if that of water be taken to be one thousand; and one-tenth of a grain one-tenth of unit, which is also the value of each of the small divisions on the stem; and accordingly, when the hydrometer is immersed in any liquid until it sinks to the middle point on the stem, the specific gravity of such fluid will be indicated by the sum of the weight of the instrument (which is, as before stated, seven hundred grains) and the grains added in the upper cup.

Suppose, for example, that, on immersing the instrument in ether, it requires thirty-four grains in the top cup to make it subside to the middle mark on the stem. The specific gravity of such ether will in this case be $700 + 34 = .734$. And on putting the instrument into alcohol or wort, if it requires in the former case one hundred and twenty-five grains, and in the latter three hundred and fifty-five, the specific gravity of the spirit will be .825, and that of the wort 1.055.

To ascertain the specific gravity of a solid, we have to take any fragment less than three hundred grains; find its weight in air, and its weight in water, and take *their difference; and on dividing its weight in air by this difference the quotient will be its specific gravity.*

The weight of a body in air is found by putting it in the *upper cup*, and adding grains until the hydrometer sinks in water to the mark on the stem. Now, as the substance and the additional weights in the cup will be altogether three hundred grains, the weight of the body will of course be so many grains as the weights put in fell short of three hundred. Its weight in water will be found by putting it into the *lower cup*, and adding grains in the *upper cup* until the instrument sinks as before: the complement of the weights in the top cup to three hundred being in like manner its weight in water.

Example.

If a body weighs in air one hundred and twenty grains, and in water one hundred and four, the difference is sixteen. On dividing one hundred and twenty by sixteen, we have for the quotient .75, or (taking, as before, the specific gravity of water at one thousand) 7.500 for the specific gravity of the body.

This instrument affords us consequently a very ready way of determining the purity or value of any alloy or metallic ore, and is therefore particularly adapted to the mineralogist. Thus, for example, the weight of a guinea, or its weight in air, is one hundred and twenty-eight grains; and if the gold is of its proper standard, it will weigh about one hundred and twenty-one grains in water, or will lose one-eighteenth part *only* of its weight in air. If it loses more, therefore, it is not of its proper specific gravity, and consequently not of standard gold.

To find the specific gravity of any of the different species of wood or other bodies lighter than water;—

after taking its weight in air as before, fix it on the small screw of the shank, and see how many grains it will then be necessary to add in the top cup, to sink the instrument to the mark, with the body on the screw; which will in this case be more than three hundred, on account of its buoyancy; and dividing its weight in air by the difference between the weights put in the top cup in each case, the quotient will be its specific gravity.

Thus, if on putting a piece of *willow* in the upper cup, it requires two hundred and fifty-eight grains to sink the hydrometer in water, the weight of the wood in air will be forty-two grains; and if on fixing it to the screw beneath, the instrument requires three hundred and twenty-eight grains to sink it to the mark in water, (being twenty-eight grains more than would be necessary to sink the instrument itself,) we have only to find the difference between the weights put into the top cup, which in this case is seventy grains; and dividing forty-two by seventy, we have .6 or .600 for the specific gravity of the wood.

For the man of science, the instrument with its set of weights is all that is necessary, and it is packed into a very small compass;* but to accommodate it to those who are concerned with spirituous liquors, and to brewers, the inventor attaches a scale, showing the relation between specific-gravities and the commercial or technical denominations of *per centage* with the former, and *pounds per barrel* with the latter.

It is needless to enumerate the various departments in which an attention to the specific gravities of bodies is now become of the first consequence, and wherein this instrument might be applied with advantage; and although many may be satisfied if they have any arbitrary standard to regulate their process by, yet it must be acknowledged that the universal standard of *specific gravity* is by far the best; for, by its currency all over Europe, it enables a person to know what relation their practice may bear to that of others in the same pursuit; and it would, by the universal adoption of it, prevent the many differences which exist among mercantile men, especially those who deal in, or pay duty on, spirituous liquors.

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* The price of it is five guineas.

Indeed the wide field which opens, on considering the importance of paying attention to the specific gravity of bodies, convinces us that we are yet in infancy on the subject.

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No. 91.

Description of an improved Gate for Fields. By Mr. CHARLES WAISTELL.[*]

(With an engraving.)

DEAR sir—The various methods used in bracing common gates for fields, prove that not one of them is greatly superior to the rest; for, if it was, that method would have been generally adopted. Most gates are loaded with superfluous timber in some of their parts, and are constructed upon such bad principles, that they are frequently broken by their own weight, aided by the concussion of the head against the falling-post; and this, long before any part of the wood has begun to decay. I have for some time given this subject considerable attention, being impressed with the idea, that if common gates could be constructed with less timber, and upon better principles, the saving of timber only would be of national importance; for we have many millions of gates to uphold in Britain, and their numbers are annually increasing. The result of my labours has been the plan which accompanies this letter. Gates made according to it, possess great strength, are very light, and of easy and simple construction. Although uniformity of appearance be not essential in a common gate, yet is worth having when it can be obtained, as in this gate, without additional expense.

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[*] Nicholson, vol. 11, p. 23. Communicated in a letter to Charles Taylor, Esquire, Secretary of the Society of Arts, who returned their thanks for the same.

My gate is made with short, and consequently less valuable, oak or ash timber, than those of the commonest construction; its strength is much greater than any other gate made with a like quantity of timber, there being at four distant points between the head and the heel, two bars and a brace crossing each other: and I doubt not that it will be found proportionably more durable: it is, besides, very easy to construct, and requires less labour than most other common gates. Twenty-nine years ago I designed plans for ornamental gates, with semi-oval and semi-circular braces, and had them executed; the plans were sent to my friends in various distant parts of this kingdom, as also to Ireland; and I have the pleasure to observe, that they are become almost the only ornamental gate in many parts of England. The plans of them I never published, although they were prepared for engraving fifteen years ago; and I should be as indifferent about my present design, of a common field gate, if I did not conceive that its publication would materially benefit the public; the introduction of this form being, I conceive, of some national importance, as timber has been lately greatly enhanced in price, and is rapidly on the advance.

This gate was designed for the approach to a country residence; but for common purposes, the wicket on one hand, and the short length of rails on the other, may be omitted. I shall thank you, if you will have the goodness to lay my plan before your respectable Society, of which I have, for many years, had the honour to be a member. And should this plan be approved of, I may probably furnish some designs for park gates on an improved construction. I am, &c.

CHARLES WAISTELL.

March 22, 1803.

To Mr. CHARLES TAYLOR.

Reference to the Engraving. Plate 15, *Fig.* 4.

DIMENSIONS.

THE heel of the gate to be about	3½ inches square.
The head of ditto . .	2½ by 3 inches.
The top rail or bar . .	3½ by 1½ inches.
The bottom bar . . .	3¼ by 1¼ inches.
The bar in the middle of the gate	3 by 1¼ inches.
The other bars, and the 4 braces	2½ by 1¾ inches.

Observations on its Construction.

THE head and heel of the gate may be of oak, and the bars and braces of fir. Narrow and thick bars, when braced as in this design, are stronger than broad and thin ones, containing the same quantity of timber, and they also oppose a less surface to the wind. The two points in the heel of the gate, to which the thimbles are fastened, may be considered as firm or fixed points. From these points, namely, 1 and 2, two braces to proceed to 4 and 3, in the middle of the bottom and top bars, and being there secured, these become fixed points, and from these two points, namely, 4 and 3, two braces proceed to

5 and 6, fixing those points. The gate is thus doubly braced, namely, from the top of the heel to the top of the head, by means of the braces 1, 4, and 4, 5; and from the bottom of the heel to the bottom of the head, by means of the braces 2, 3, and 3, 6. On each side of the gate are two braces, and those parallel to each other. The brace proceeding from the bottom of the heel of the gate, and that which is parallel to it, as also the bottom bar, all strained in the way of compression, and the brace proceeding from the top of the heel, and the other brace which is parallel to it, and also the top bar, are all strained in the way of extension. The strains in this gate being none of them transverse, but all longitudinal, it would support a vast weight at its head without having its form altered. The braces all serve the double purpose of keeping the gate in its true form, and of shortening the bearings of the bars, and strengthening them. Few gates have less timber in their braces; and perhaps in no other way can a gate be so firmly braced with so small a quantity of timber.

At 3, 4, 7, and 8, two braces and a bar of the gate are firmly screwed together by means of iron pins and screw nuts. At the other points, where only one brace crosses a bar, common gate-nails are used.

If, in some cases, a strong top-bar be wanted, to resist the pressure of heavy cattle, a bar or board, about six inches broad, and one inch thick, may be laid with its broad side upon the top bar, and fixed thereto by means of the ends of the braces in the middle, and by the heel and head of the gate at the two ends of it. This board will, in this position, resist exactly the same pressure as a thick top bar, three inches broad, by four inches deep, although it contain no more than half the timber.

In the ground plan, or horizontal section, fig. 7, represents a piece of wood, about four inches cube, pinned to the falling post, a little below the catch, to stop the gate from swinging beyond the post: another stop near the ground may be useful.

When gates are hung to open one way only, their heels and heads generally rest against the hanging and falling posts; but when they are hung according to this design, gates may be made about one foot shorter for the same opening, and consequently they must be lighter, stronger, and less expensive.

Of the hanging of Gates.

When the two hooks in the hanging-post are placed in the same perpendicular line, a gate, like a door, will rest in any direction in which it may be placed. But, in order that a gate may shut itself when thrown open, the hooks are not placed exactly perpendicular; the upper hook declining a little towards the falling-post, or a few feet beyond it. In whatever direction that hook declines the farthest, in the same direction will the gate rest, if unobstructed, and its head cannot then sink any lower. Make the head describe half a circle, and it will thus have attained its utmost elevation, and will be equally inclined to descend either to the right or to the left.*

The following method of fixing the hooks and thimbles, will, I think, be found to answer very well for a gate that is intended to open only one way. Supposing the face of the hanging-post to be set perpendicular, and the upper hook driven in near its inner angle, as is represented in the preceding design, and that the lower hook must be four feet and a half below it; suspend a plumb-line from the upper hook, and at four feet and a half mark the post; then at one inch and a half farther from the gateway than this mark, drive in the lower hook; this hook must project about half an inch farther from the face of the post than the upper hook. In the section or ground-plan of the gate, the two white circles near the hanging-post represent the places of the two hooks when brought to the same horizontal line; that nearest the gateway represents the place of the upper hook. A line drawn through the middle of these two circles, and extended each way, will, on one hand, represent the gate's natural line of rest, and, on the other, the line of its highest elevation. A gate thus hung will, when thrown open nearly to the line of its highest elevation, return to the falling-post with a velocity sufficient to resist a moderately strong wind. This velocity will be either increased or diminished, accordingly as the upper hook declines more or less from a position perpendicular to the lower hook. In order to adapt the thimbles to these hooks;—as the lower hook is one inch and a half farther from the gateway than the upper hook, the lower thimble must have its eye an inch and a half farther from the heel of the gate than the eye of the upper thimble, in order that the bars of the gate may be in a horizontal position when it is shut. And, as the upper hook projects half an inch less from the hanging-post than the lower hook, the upper thimble should be fixed half an inch nearer the farther side of the heel of the gate than the lower thimble, in order that the gate may be in a perpendicular position when shut. If the thimbles have straps embracing the heel of the gate, and proceeding a few inches along each side of the bottom and top bars, and if they are fixed to the heel bars and braces, by means of iron pins and screw nuts, great firmness will be given to the gate at those two points, which are those that suffer the greatest strains.

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* See Chap. 2, of Mr. Parker's Essay on the Hanging of Gates; and also the Agricultural Report for Northumberland, by Messrs. Bailey and Culley.

END OF VOLUME SECOND.

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